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PREDICTED OIL SLICK MOVEMENT FROM VARIOUS LOCATIONS OFF THE NEW JERSEY-DELAWARE COASTLINE

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June 1975

Final Report

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N O T I C E

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16. Abstract

Projections of the movement of oil slicks and their impact location along the shoreline of New Jersey and Delaware were determined from three potential deepwater port sites and three potential oil drilling sites. Average monthly wind speeds and directions and average monthly current patterns were used for predicting the oil slick movement. Probable areas of impact along the shoreline were indicated.

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1.0 SUMMARY

1.1 Purpose and Scope

There are a number of potential oil drilling sites and deepwater port sites along the east coast of the United States. To understand the ecologic and economic implications of a spill from any of these sites, projections of the movement of oil slicks and their impact location along the shoreline must be determined.

Investigations of the movement of potential oil spills from three deepwater port sites and three potential drilling sites (Figure 1) off the New Jersey-Delaware coastline were conducted. The paths of movement of oil slicks from these sites were predicted using average monthly wind speeds and directions and average monthly current patterns.

1.2 Conclusions

a. The greatest danger of an oil spill impacting the shoreline occurs when wind directions vary between northeast and south. These wind directions are most frequently associated with coastal storms. The longer a low pressure system remains in the area and produces wind directions between northeast and south, the more likely the oil slick will move toward the shoreline.

b. The most rapid movement of an oil slick toward the coastline occurs when wind direction is from the east or southeast. Predictions based on these wind directions and average monthly wind speeds as well as monthly current patterns indicate:

(1) Slicks from DWP 1 will take 1-2 days to impact on the shoreline.

(2) Slicks from DWP 2 will take 3-4 days to impact the shoreline.

(3) Slicks from DWP 3 will take 1-3 days to impact the shoreline.

(4) Slicks from Site 1 will take 4-7 days to impact the shoreline.

(5) Slicks from Site 2 will take 4-9 days to impact the shoreline.

(6) Slicks from Site 3 will take 4-13 days to impact the shoreline.

c. Figures 37-51 are yearly composites of probable impact areas (Figures 2-36) along the New Jersey-Delaware coastline. The numbers indicate the number of months that an oil slick will impact that area of the beach from a particular site under a given wind condition.

Those areas with high numbers are most susceptible to impact by oil spills during one year.

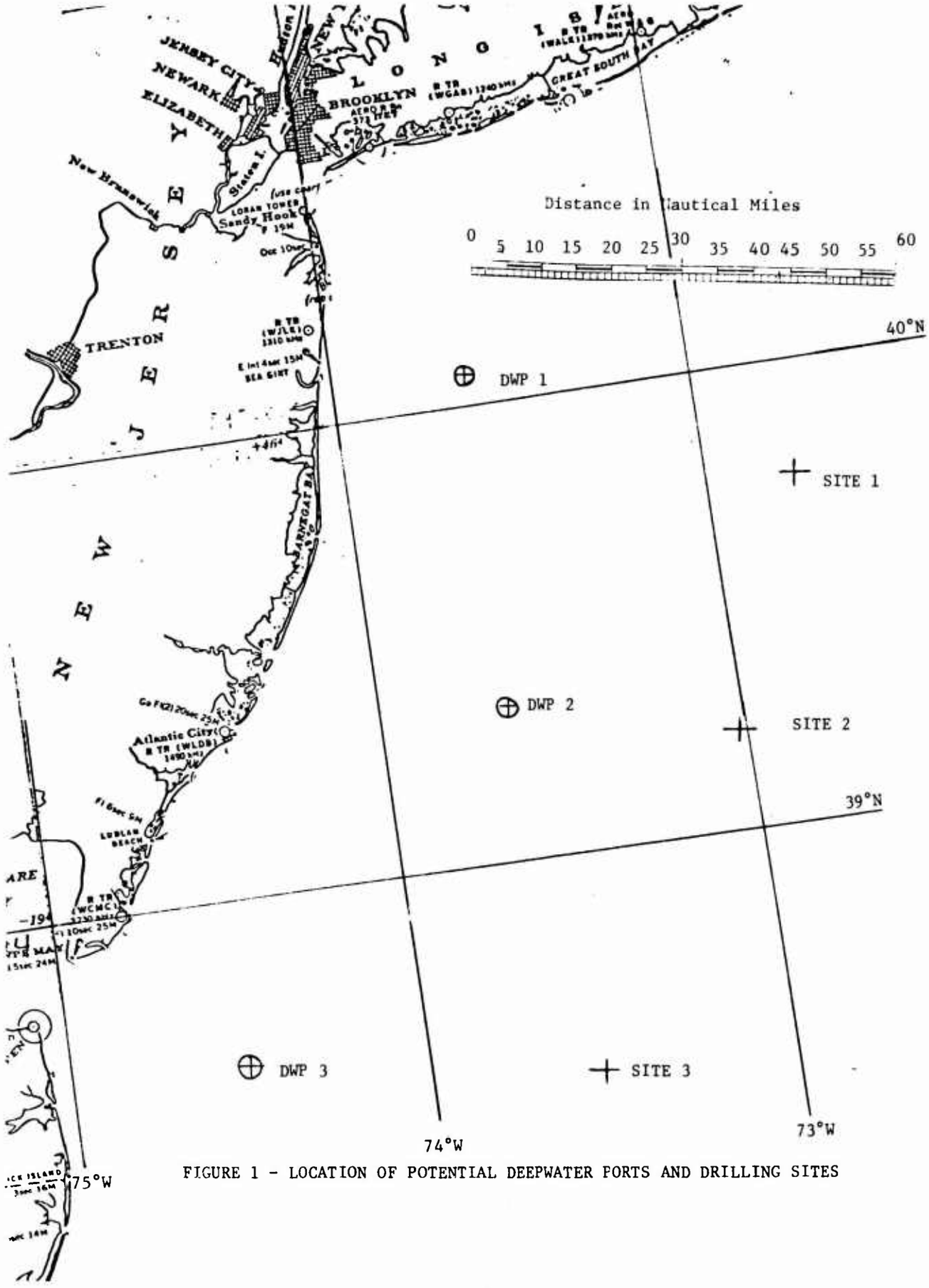


FIGURE 1 - LOCATION OF POTENTIAL DEEPWATER PORTS AND DRILLING SITES

d. The table below shows the number of months per year that a slick will impact the New Jersey-Delaware shoreline for each DWP site or drill site for a given wind direction.

TABLE 1

Number of Months Per Year Oil Slick Will Impact Shoreline for Each Location

Wind Direction	DWP 1	DWP 2	DWP 3	Site 1	Site 2	Site 3
SW	2	0	0	0	0	0
S	11	11	11	10	10	4
SE	11	12	11	11	12	3
E	12	12	6	11	7	0
NE	11	3	0	0	0	0

1.3 Recommendations

Predictions of oil slick movement were based on monthly wind averages and monthly average current patterns. For greater precision in determining the most vulnerable areas of the shoreline a more sophisticated technique should be used. A computer model for this area should be developed (either a new model or an adapted model) and used to predict oil slick movement. The development of a computer model requires that at least one year be devoted to the collection of oceanographic and meteorologic data in the area of the model. These data would be used to verify the accuracy of the model. Once verified, the model could produce actual drift tracks of oil slicks anywhere in the area if appropriate inputs are given each time a solution is needed.

2.0 DATA

2.1 Wind Data

Surface winds play an important role in the transport of oil on the water. A wind continuing for some time will produce a current the velocity of which depends on the velocity of the wind. The wind drift of an oil slick can be described by a wind factor: oil slick drift rate as a percentage of speed. The wind factor used for the predictions of movement of oil slicks off the New Jersey-Delaware coastline was 3.5%. This value is in good agreement with wind factors observed for the Torrey Canyon slick, 3.4%, and the Gerd Maersk slick, 4.3% (Tomczak, 1964). In addition, Smith (1974) calculated a wind factor of 3.64% ±0.51% based on his determination of the leeway of oil slicks. These values agree well with the value obtained by Schwartzberg (1970) from experiments in a small scale test basin, 3.66% ±0.17%. Lissauer (1974) used the value of 3.5% successfully to predict the movement of oil spills in New York Harbor. The value of 3.5% can be used to predict the wind drift of an oil slick for winds up to 20 knots. Above this speed wave-induced drift appears to be a significant factor in determining the drift of slicks. Because

the relationship between wind drift and wave drift is quite complex and this value has not been quantified, it has been ignored in the forecasting procedure.

Disagreement persists over the magnitude of deviation from wind direction to be expected for oil slick movement. In mid-latitudes of the Northern Hemisphere drift angle can be expected to be to the right of the true wind. However, in shallow water the deflection is at a minimum because frictional forces balance the Coriolis force. Oil slick drift observed by Smith (1974) was directly downwind as was the drift of the Torrey Canyon slick. For predicting the movement of oil slicks off the Delaware-New Jersey coastline, it was assumed that oil slicks move directly downwind.

Wind roses showing the monthly distribution of surface winds from eight directions (N, NE, E, SE, S, SW, W, NW) and the average monthly speed for each direction were constructed for the Atlantic City area, and the areas north and south of Atlantic City. The data used to prepare the wind roses are available from the U. S. Naval Weather Service Command, Summary of Synoptic Meteorological Observations (1970, 1975). The wind roses in conjunction with constructed monthly surface current patterns were used to predict the movement of oil slicks from the three deepwater port sites and the three drilling sites.

2.2 Current Data

To obtain the surface current structure in the desired area, it was necessary to assess the results of work previously completed in the New York Bight, the mid-Atlantic Bight, and Atlantic outer-continental shelf areas. This assessment was combined with generally accepted physical and dynamical concepts for the area as presented by Bumpus (1973) and Charnell and Hansen (1974). This information was used to construct twelve monthly surface current charts for the area from Long Island to Cape Hatteras and from the shoreline eastward to 70°W.

Considering that a time scale of one month was used, Gulf Stream meanders normally appearing at a frequency of a few days were smoothed out of the monthly averages. This is reasonable because observed meanders have been east of the area of interest and therefore would not affect this work.

There are no more than four or five recent oceanographic studies in the area. Bumpus (1973) has contributed much on the New York Bight and the near coastline south of the Bight. The NOAA Mesa project has contributed information in the same area. The U. S. Coast Guard Oceanographic Unit has been experimenting with surface current charts based on ART flight results. These charts provide the user with a surface current regime purported to be "accurate" for approximately a two-week period. Although this work is still being evaluated, when one looks at one year of compiled charts, a reasonable current regime can be seen.

Another contributing work, completed by NAVOCEANO (1975), is the summarized surface-current/ship-drift data analyzed on a monthly basis for

Marsden sub-squares. The data base for this dates back to 1904. Other studies have been completed for the area, some originating from the University of Delaware, from Boicourt (1974) with the Johns Hopkins University, other NAVOCEANO studies, the U. S. Environmental Protection Agency, and EG&G (1975). Important facts agreed upon by all investigators include:

a. On the continental shelf, the primary flow is southwest throughout the entire year at both the surface and along the bottom.

b. The surface circulation and geostrophic flow are markedly affected by persistent winds.

c. The net drift along the entire coast is density driven.

d. Estuarine flow may be expected inshore at the mouths of large bays (e.g., at the entrance to New York Harbor, the net flow is relatively fresh and outbound at the surface, and salty and inbound along the bottom).

e. The small scale flow at the entrance to New York Harbor is primarily tidal dominated.

f. Large variations throughout the area may be caused by meteorological events and meanders from persistent currents.

g. The Gulf Stream and Labrador currents exist as persistent currents.

The monthly charts used in this work were constructed by plotting the monthly mean currents reported by the various investigators and graphically computing an average vectorial picture of all the plots. A review of this work showed that the monthly current picture does depict a temporal variation in the general flow patterns. However, this temporal variation more aptly corresponds to the large scale of a seasonal change. These current patterns are subject to small scale perturbations caused by low pressure systems moving through the area. These perturbations are equivalent to small scale temporal variations and were not depicted in this study.

The constructed charts showed surface layer movement, and it was assumed that the oil moves in the same direction and with the same speed as the water. This assumption is valid for predicting the oil/water movement vector so long as one realizes that this movement refers to the center of the oil spill. The spreading of the oil on the surface of the water requires other considerations.

Fay and Hoult (1971) have developed spreading functions for an oil spill. Lissauer (1974) applied these to the predictive techniques developed for New York Harbor with satisfactory results. For this offshore study in large unrestricted water areas, it will require on the order of days for the center of an oil spill to impact the coastline. By applying the spreading functions to spills of various sizes, one alters the time of impact by only a few hours. In addition, the general areas

of shoreline (Figures 2-36) where oil was predicted to impact would remain the same for spills of 10,000 barrels or 1,000,000 barrels. Therefore, various spill sizes were not used in the movement predictions.

The method used to predict the movement of the oil was to add the surface current vector and the wind vector determined from the wind data. The resultant vector showed the movement of the center of an oil spill, regardless of size, as it was affected by wind and surface current. This method was applied to the three DWP sites and the three drill sites. For each month, trajectories were computed for those directions of the wind which would result in impact on the coastline (Figures 2-36). These movements and pertinent data are summarized in Tables 1A-71A.

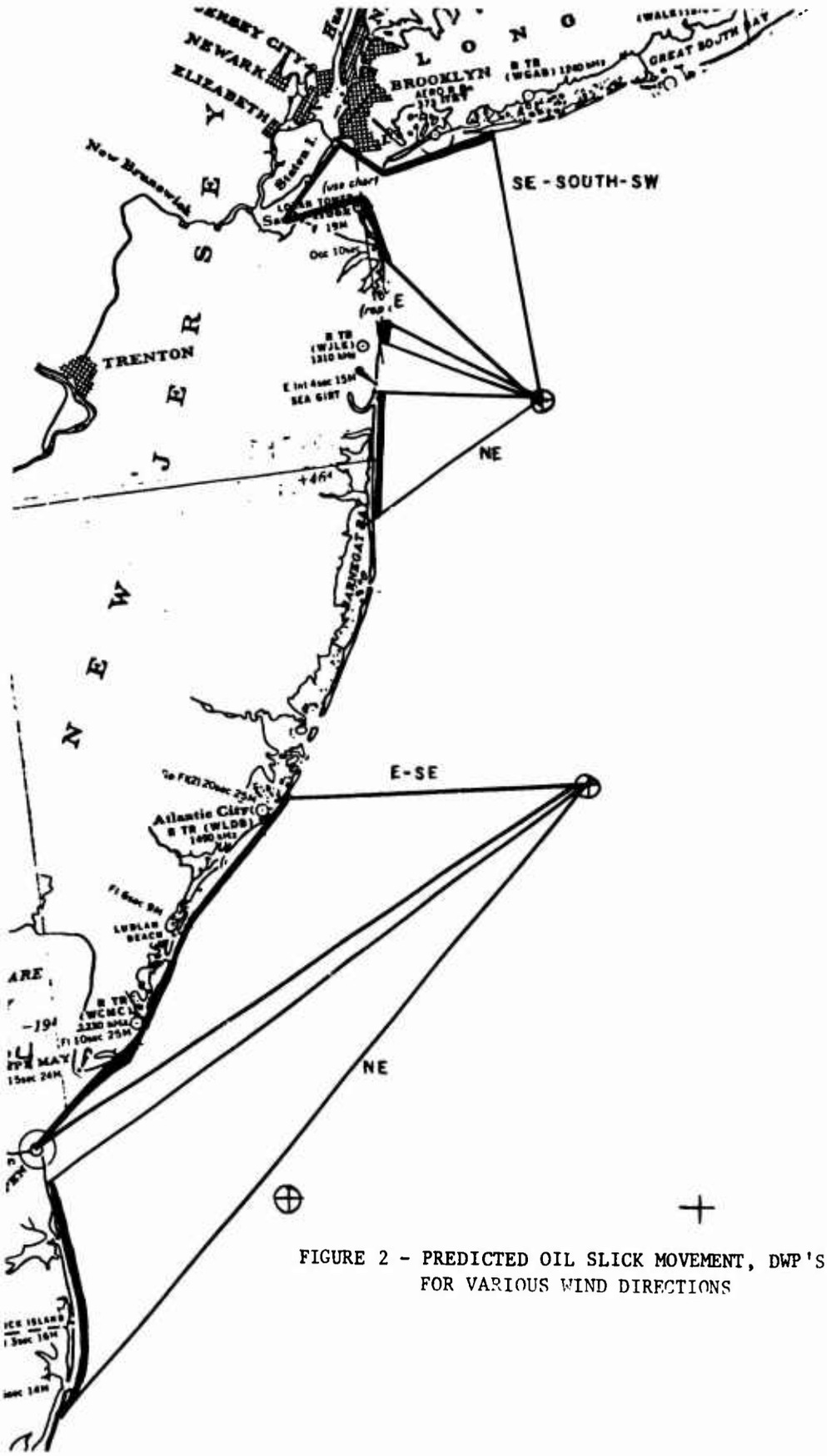


FIGURE 2 - PREDICTED OIL SLICK MOVEMENT, DWP'S 1 & 2, JANUARY FOR VARIOUS WIND DIRECTIONS

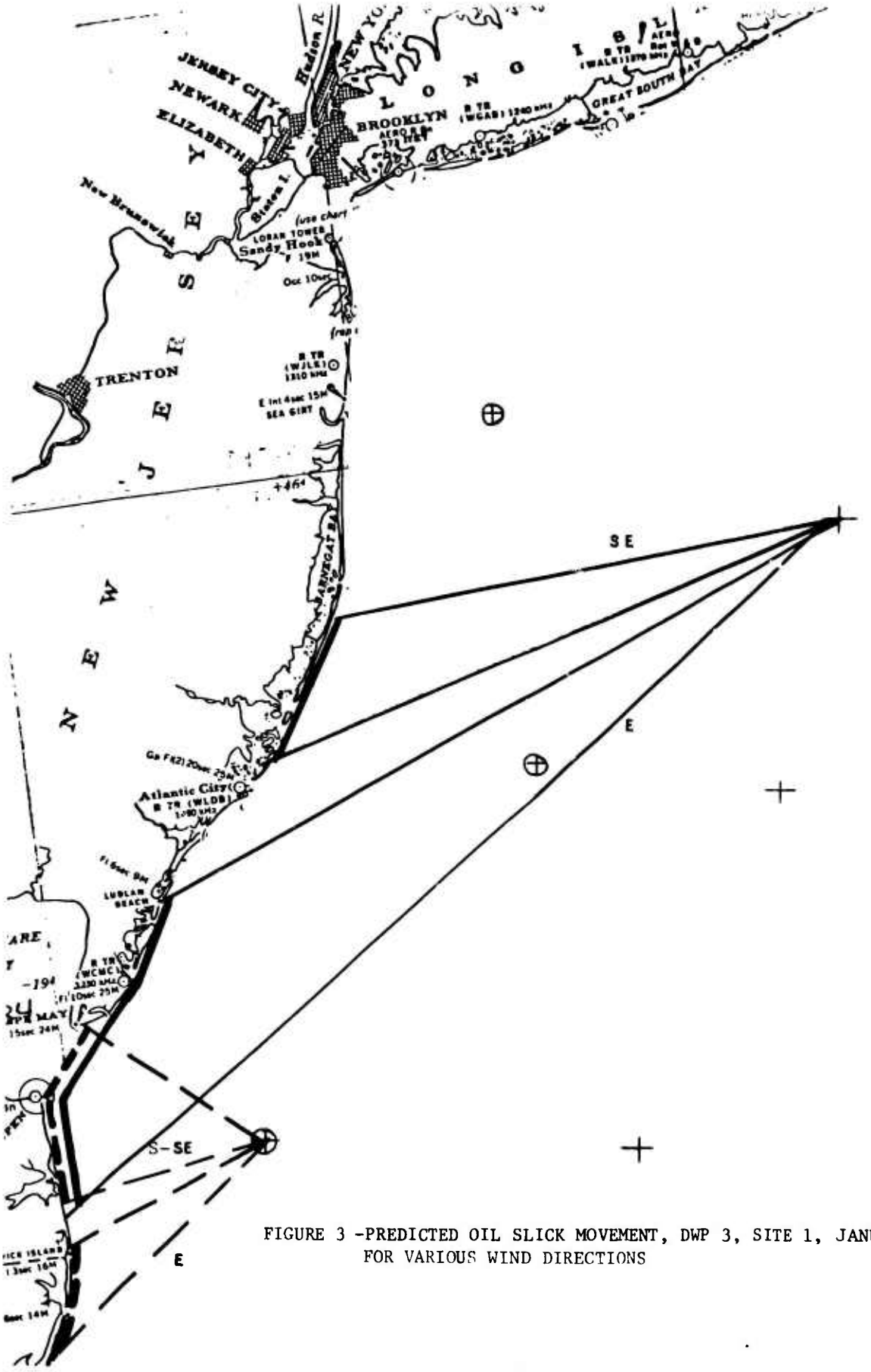


FIGURE 3 -PREDICTED OIL SLICK MOVEMENT, DWP 3, SITE 1, JANUARY FOR VARIOUS WIND DIRECTIONS

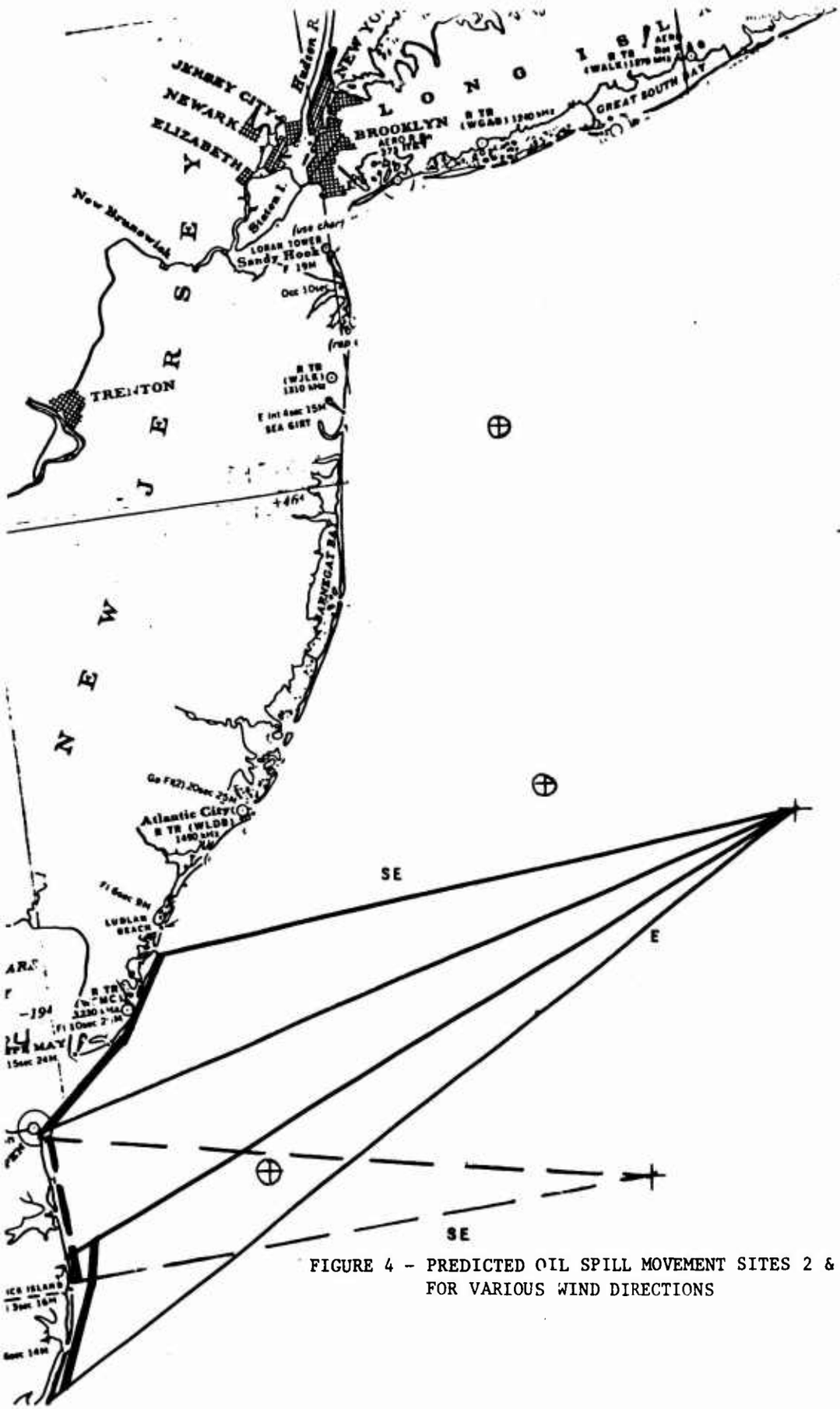


FIGURE 4 - PREDICTED OIL SPILL MOVEMENT SITES 2 & 3, JANUARY FOR VARIOUS WIND DIRECTIONS

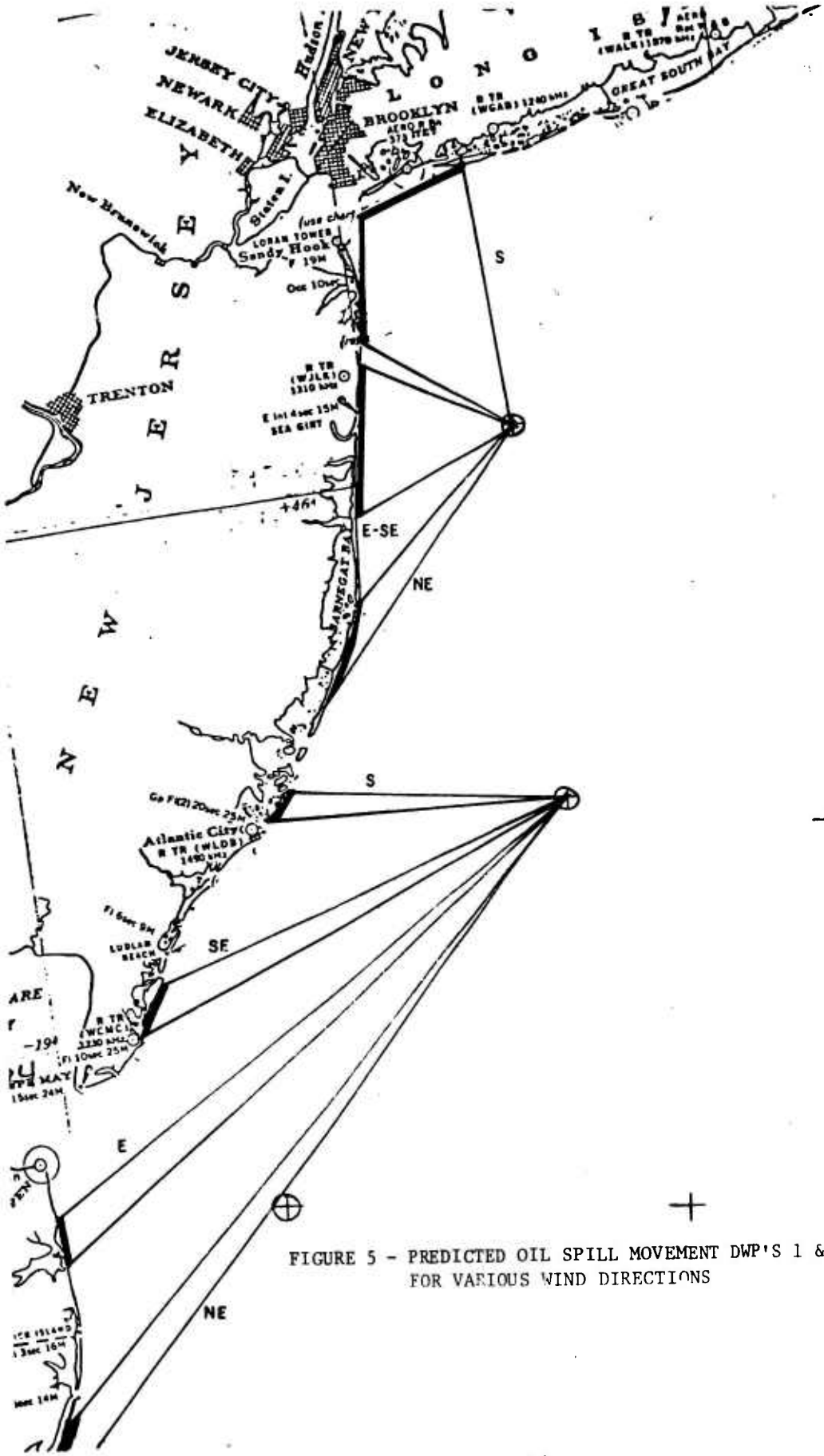


FIGURE 5 - PREDICTED OIL SPILL MOVEMENT DWP'S 1 & 2, FEBRUARY FOR VARIOUS WIND DIRECTIONS

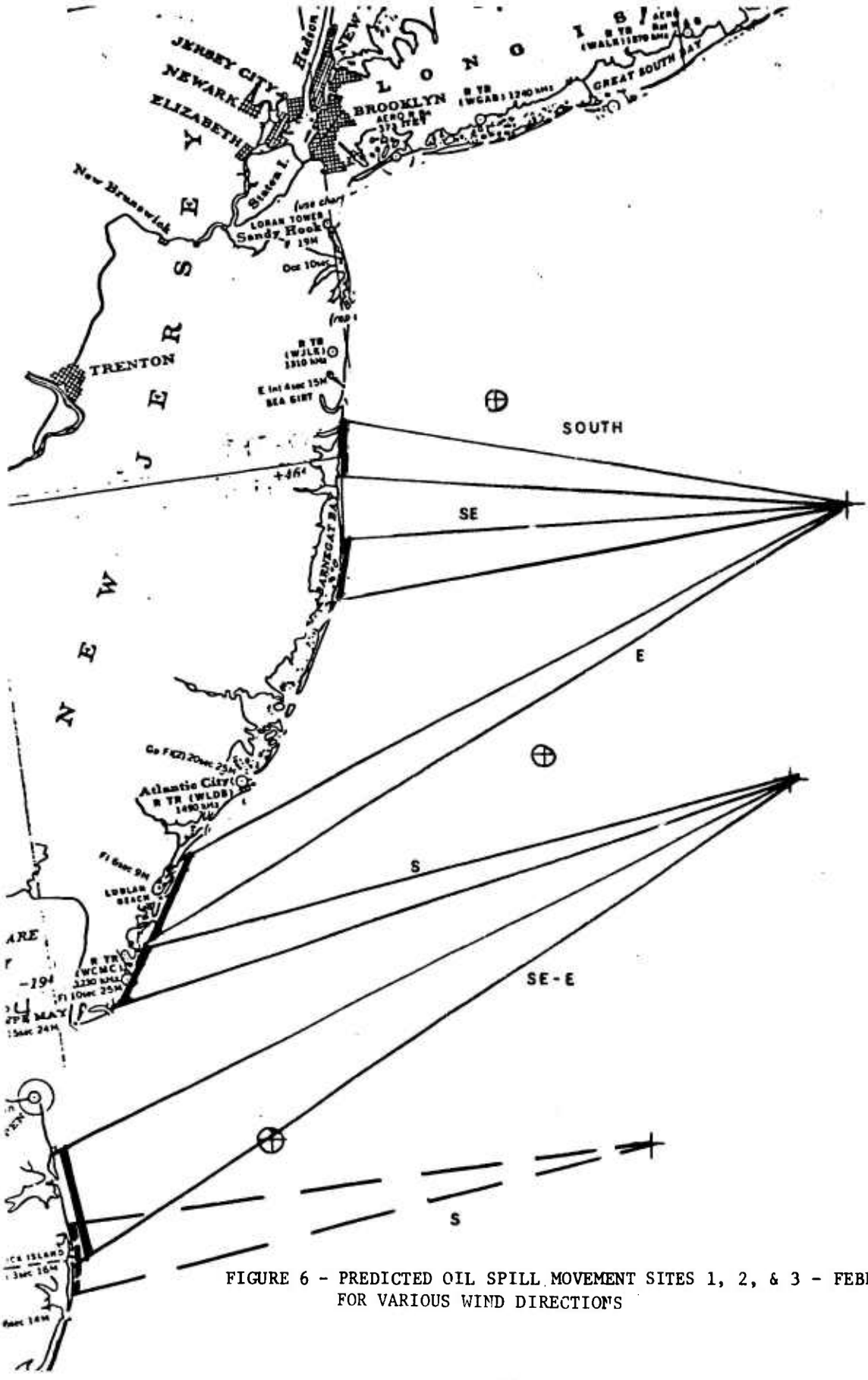


FIGURE 6 - PREDICTED OIL SPILL MOVEMENT SITES 1, 2, & 3 - FEBRUARY FOR VARIOUS WIND DIRECTIONS

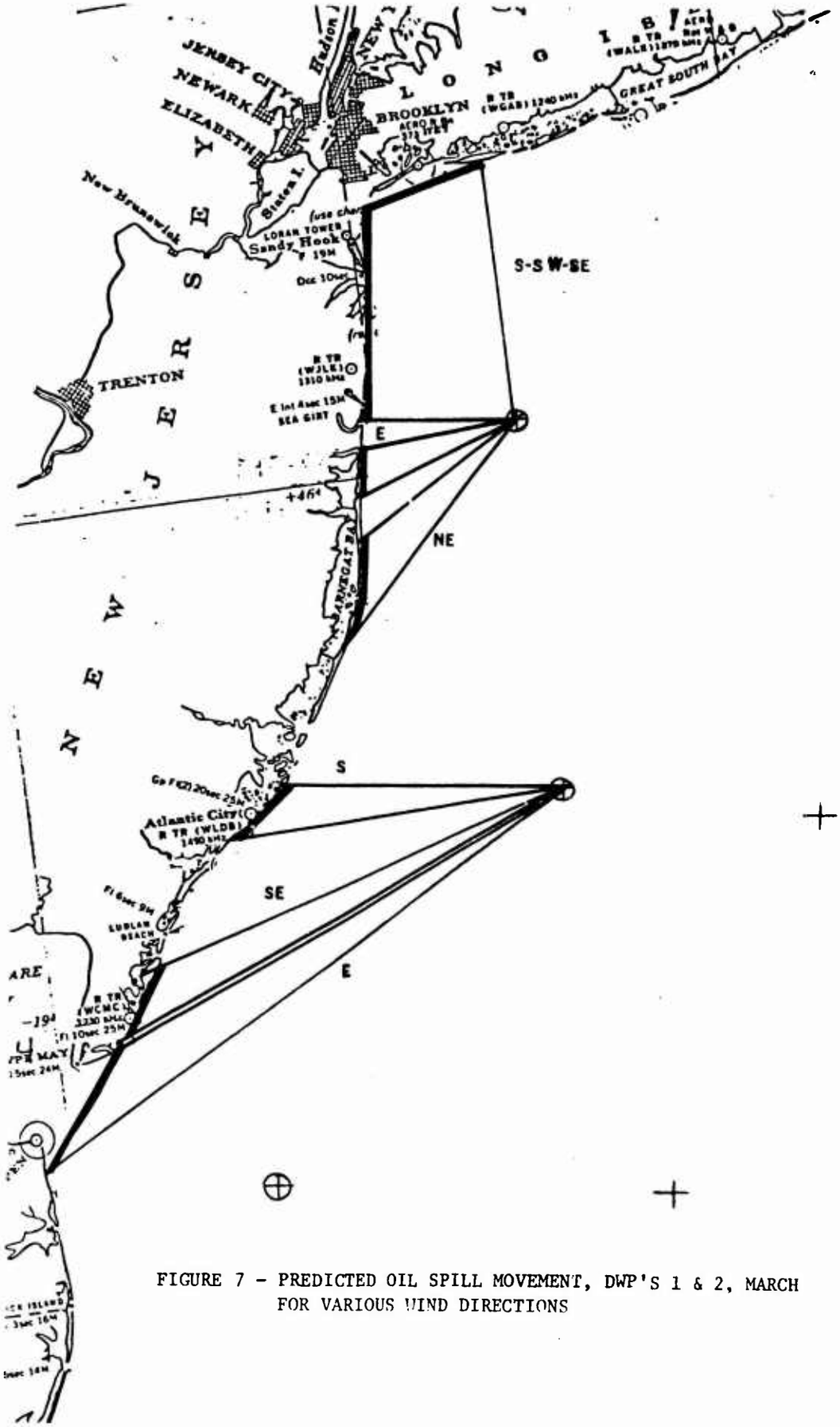


FIGURE 7 - PREDICTED OIL SPILL MOVEMENT, DWP'S 1 & 2, MARCH FOR VARIOUS WIND DIRECTIONS

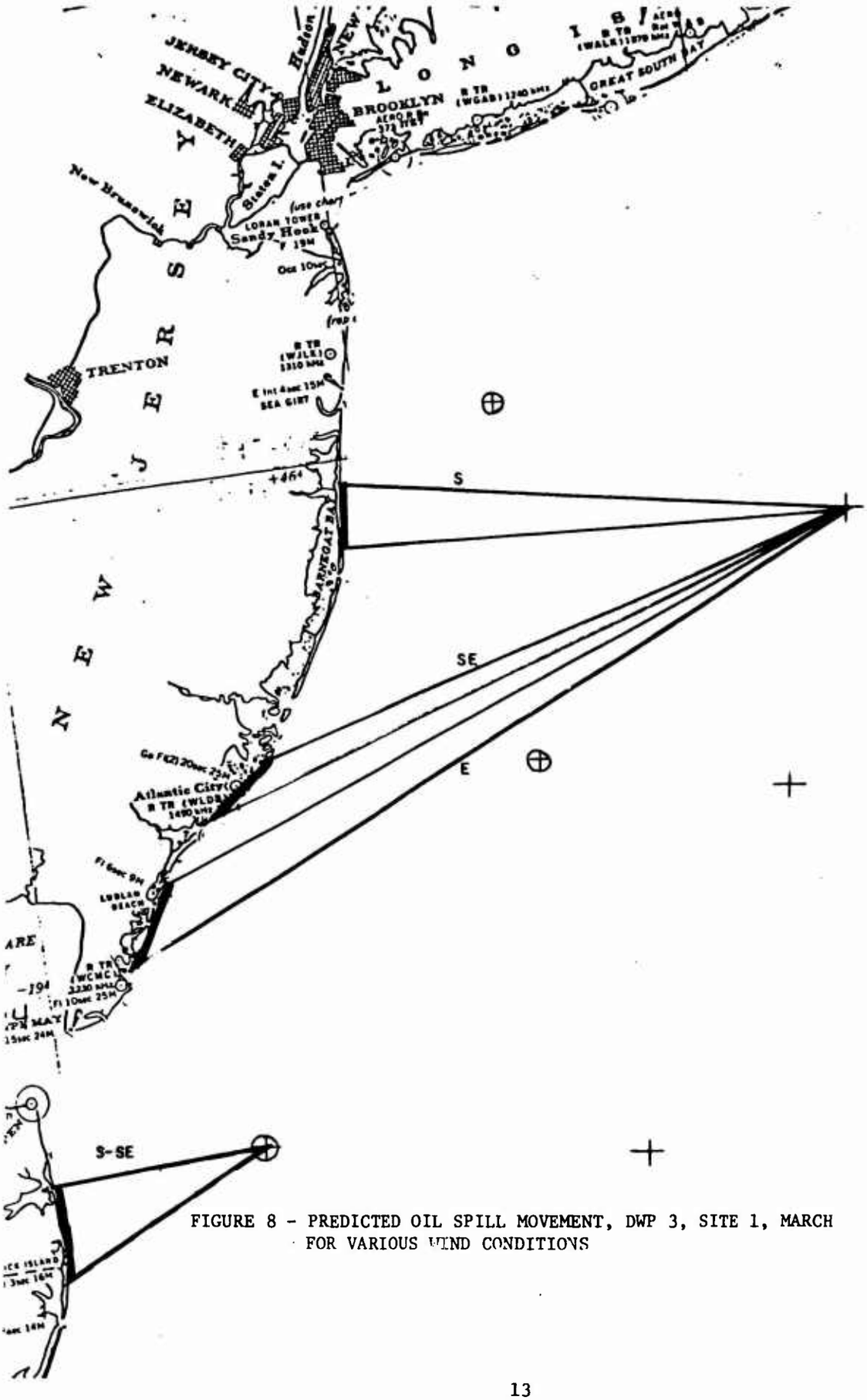


FIGURE 8 - PREDICTED OIL SPILL MOVEMENT, DWP 3, SITE 1, MARCH FOR VARIOUS WIND CONDITIONS

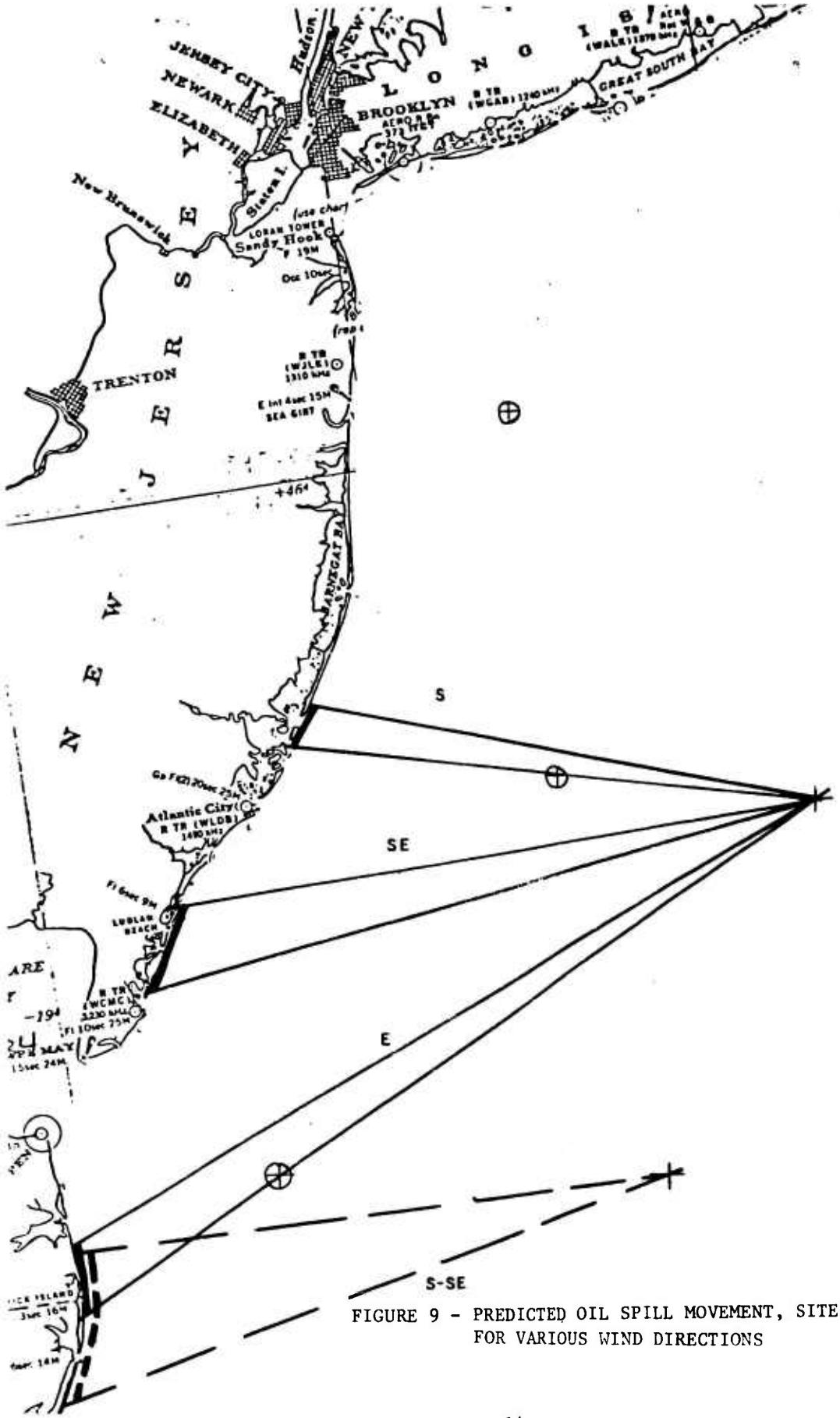


FIGURE 9 - PREDICTED OIL SPILL MOVEMENT, SITES 2 & 3, MARCH FOR VARIOUS WIND DIRECTIONS

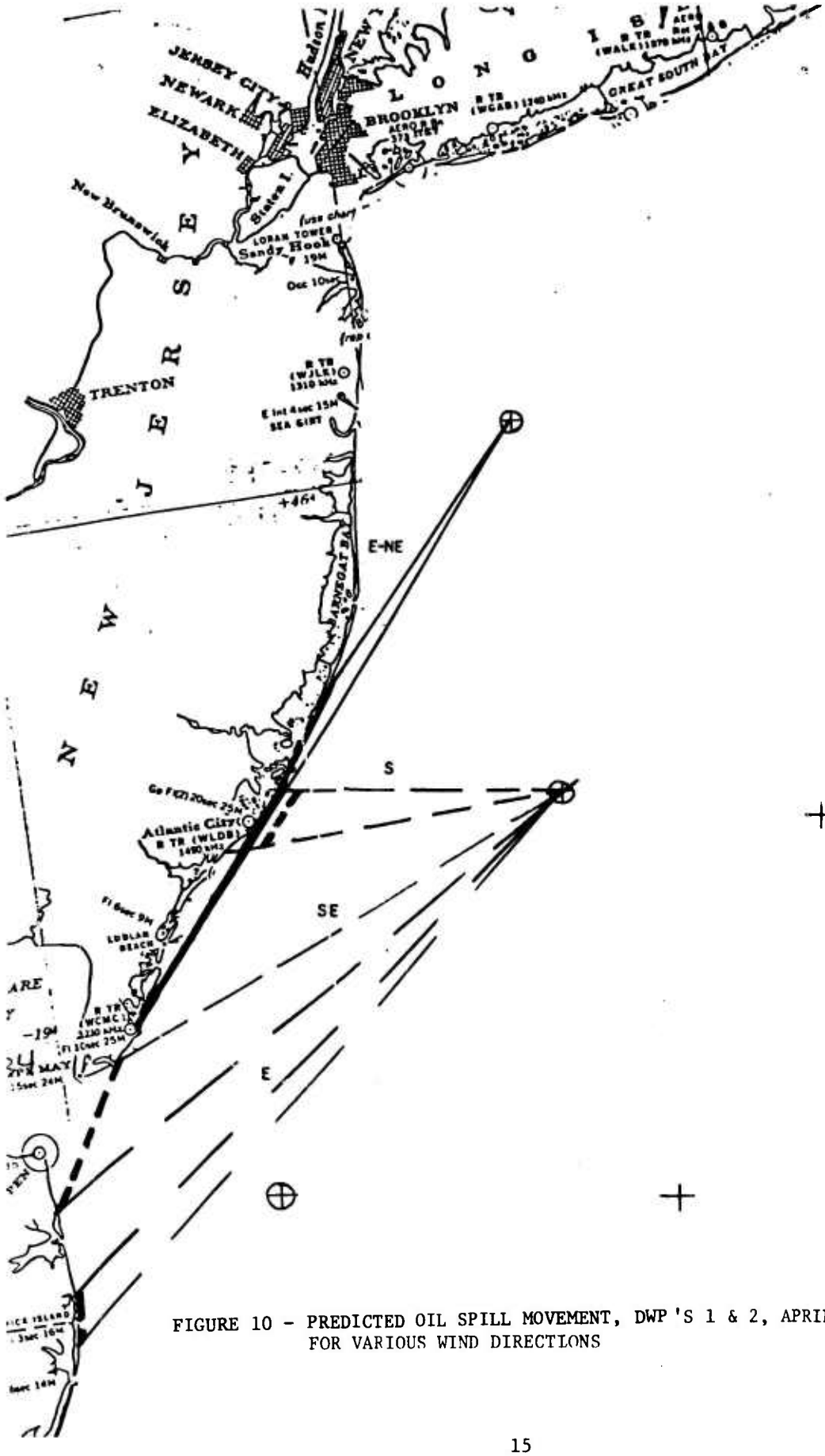


FIGURE 10 - PREDICTED OIL SPILL MOVEMENT, DWP 'S 1 & 2, APRIL FOR VARIOUS WIND DIRECTIONS

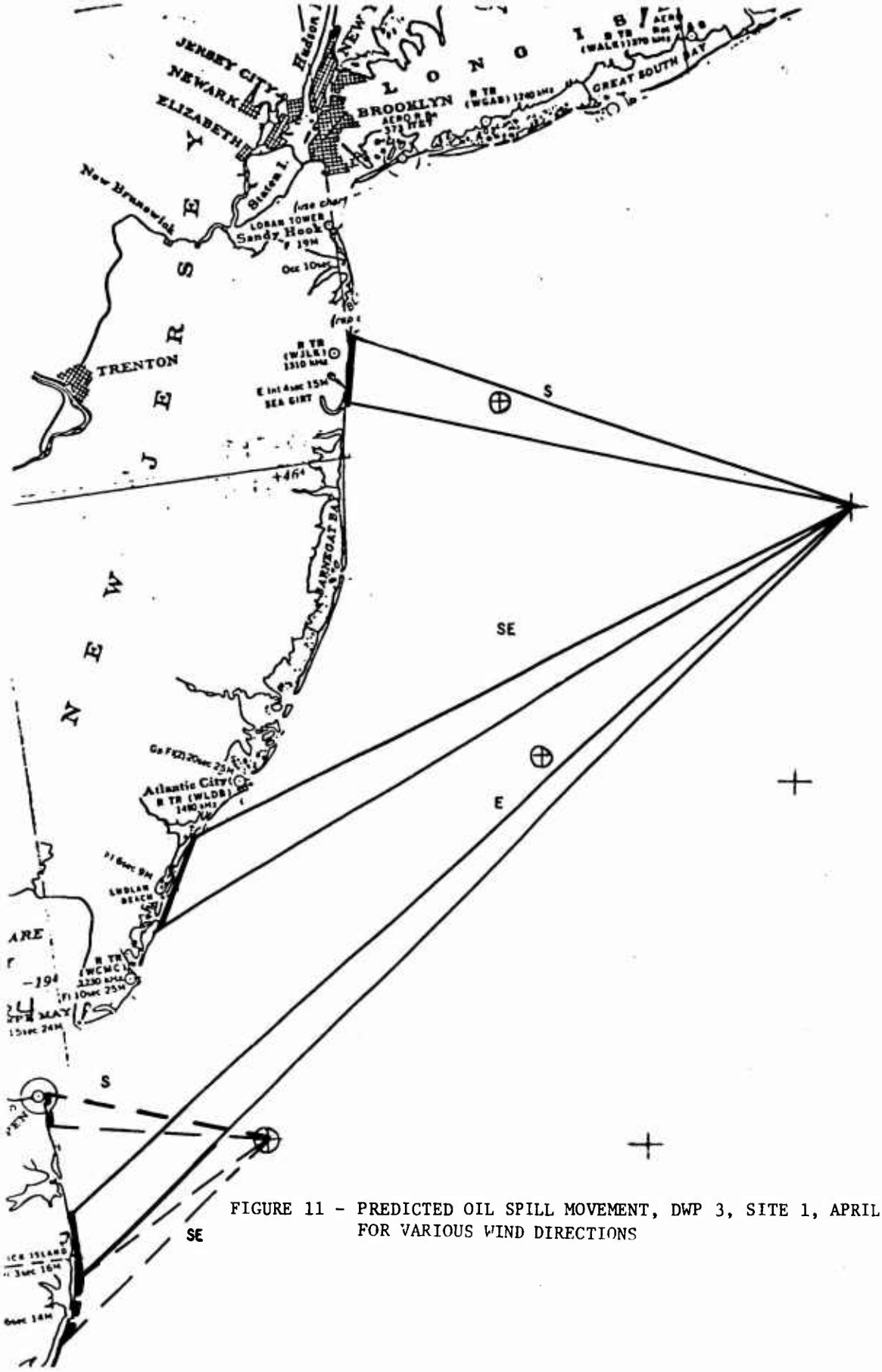


FIGURE 11 - PREDICTED OIL SPILL MOVEMENT, DWP 3, SITE 1, APRIL FOR VARIOUS WIND DIRECTIONS

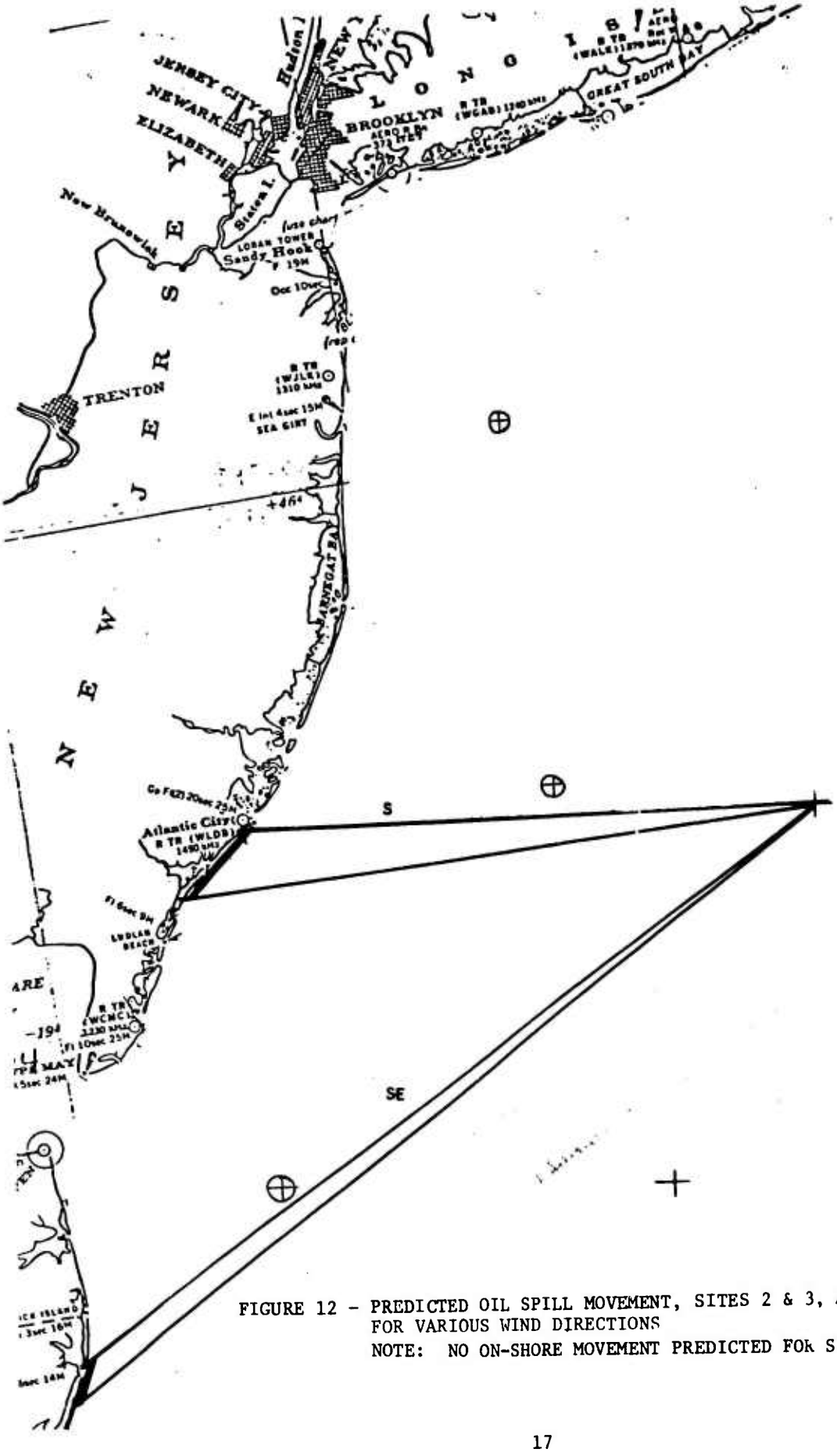


FIGURE 12 - PREDICTED OIL SPILL MOVEMENT, SITES 2 & 3, APRIL FOR VARIOUS WIND DIRECTIONS
NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 3.

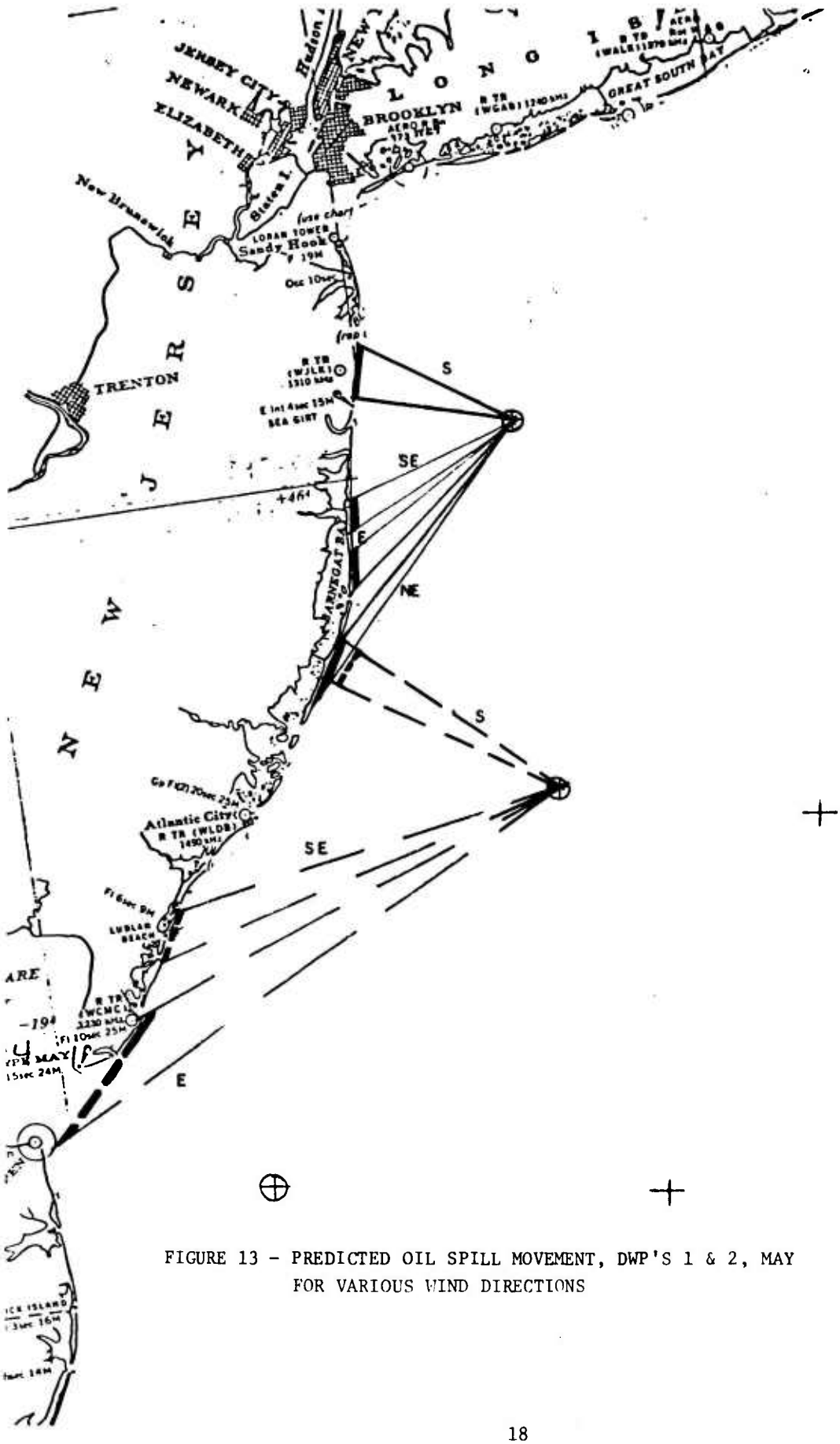


FIGURE 13 - PREDICTED OIL SPILL MOVEMENT, DWP'S 1 & 2, MAY FOR VARIOUS WIND DIRECTIONS

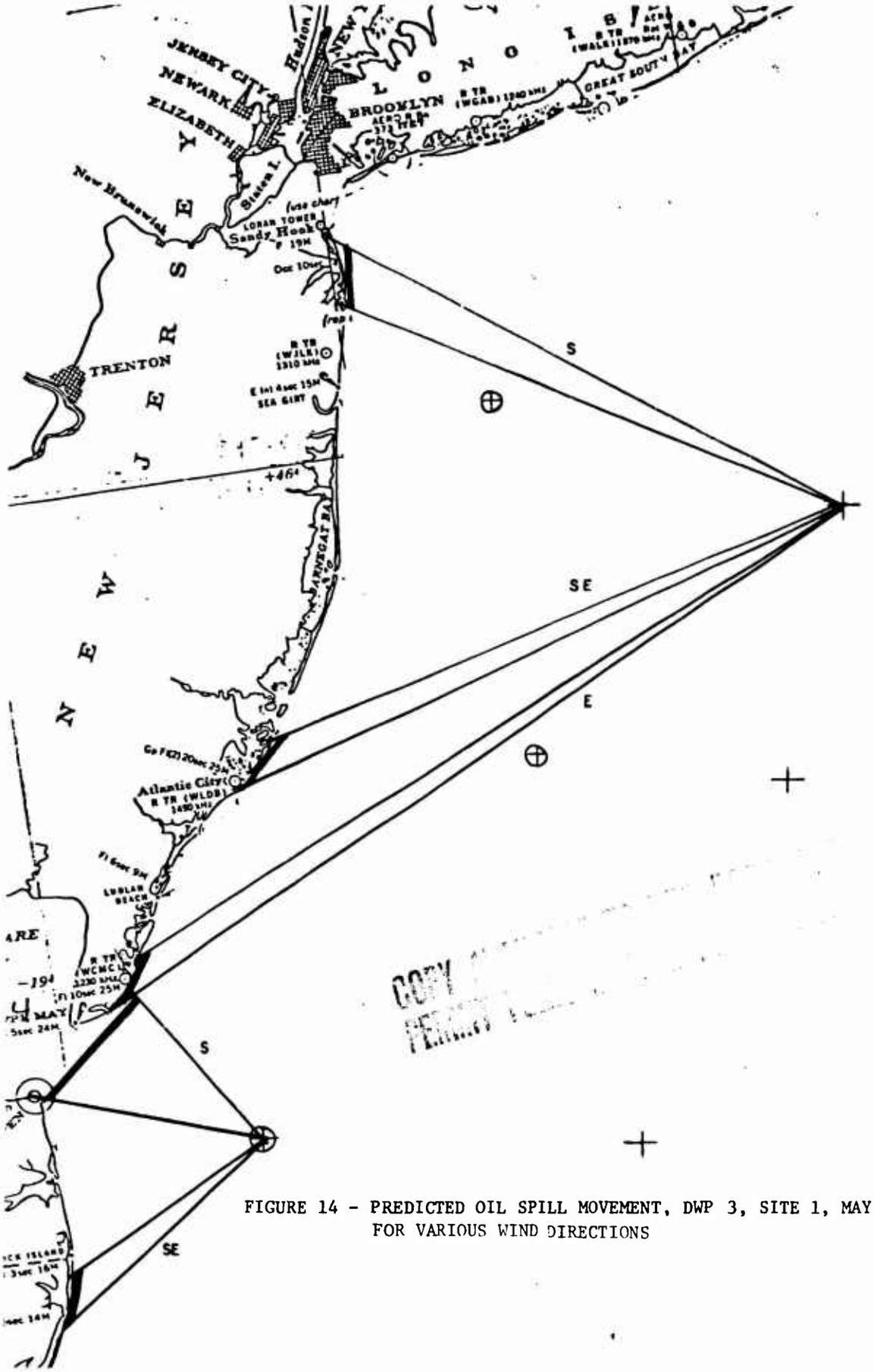


FIGURE 14 - PREDICTED OIL SPILL MOVEMENT, DWP 3, SITE 1, MAY FOR VARIOUS WIND DIRECTIONS

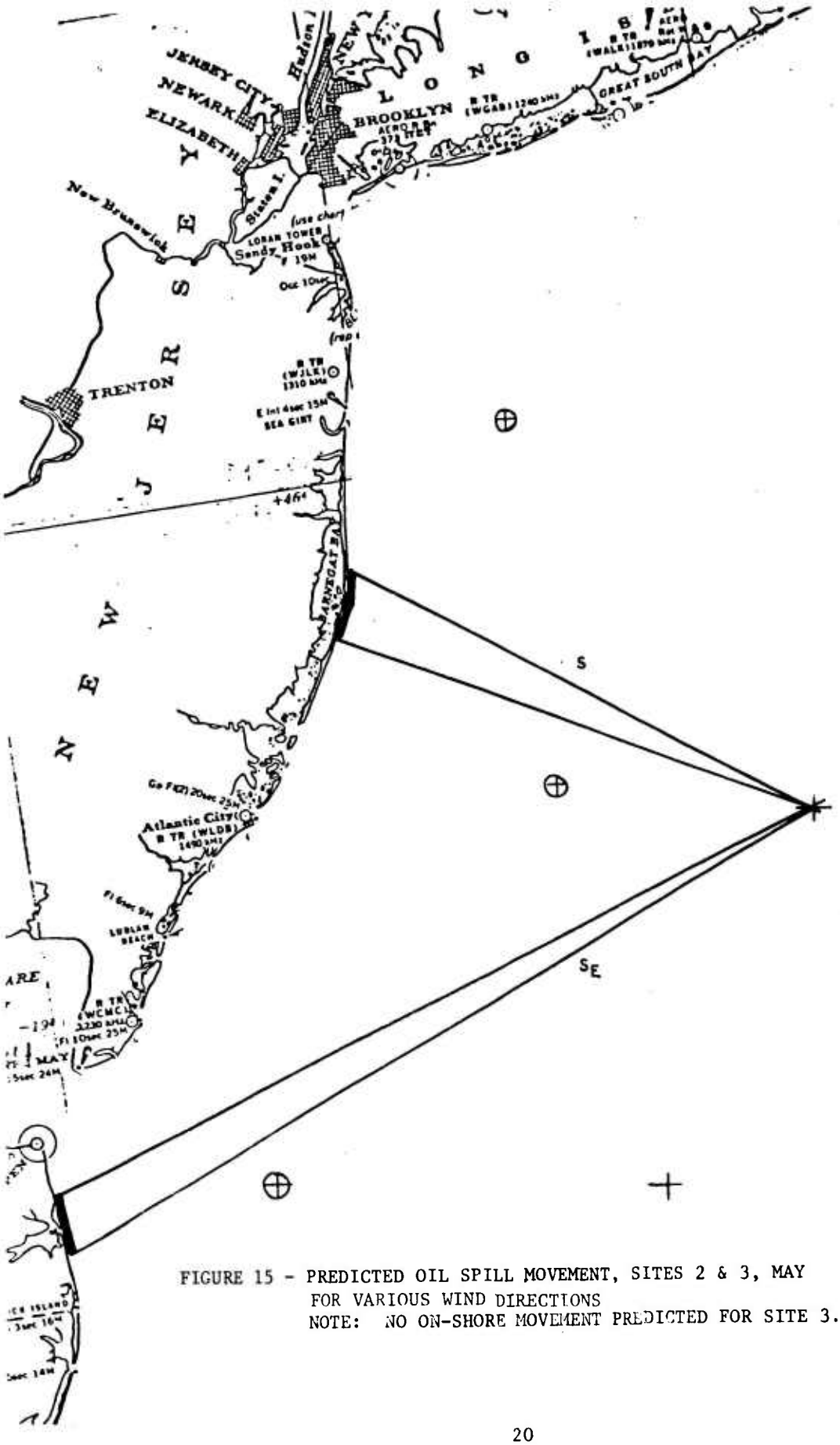


FIGURE 15 - PREDICTED OIL SPILL MOVEMENT, SITES 2 & 3, MAY
FOR VARIOUS WIND DIRECTIONS
NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 3.

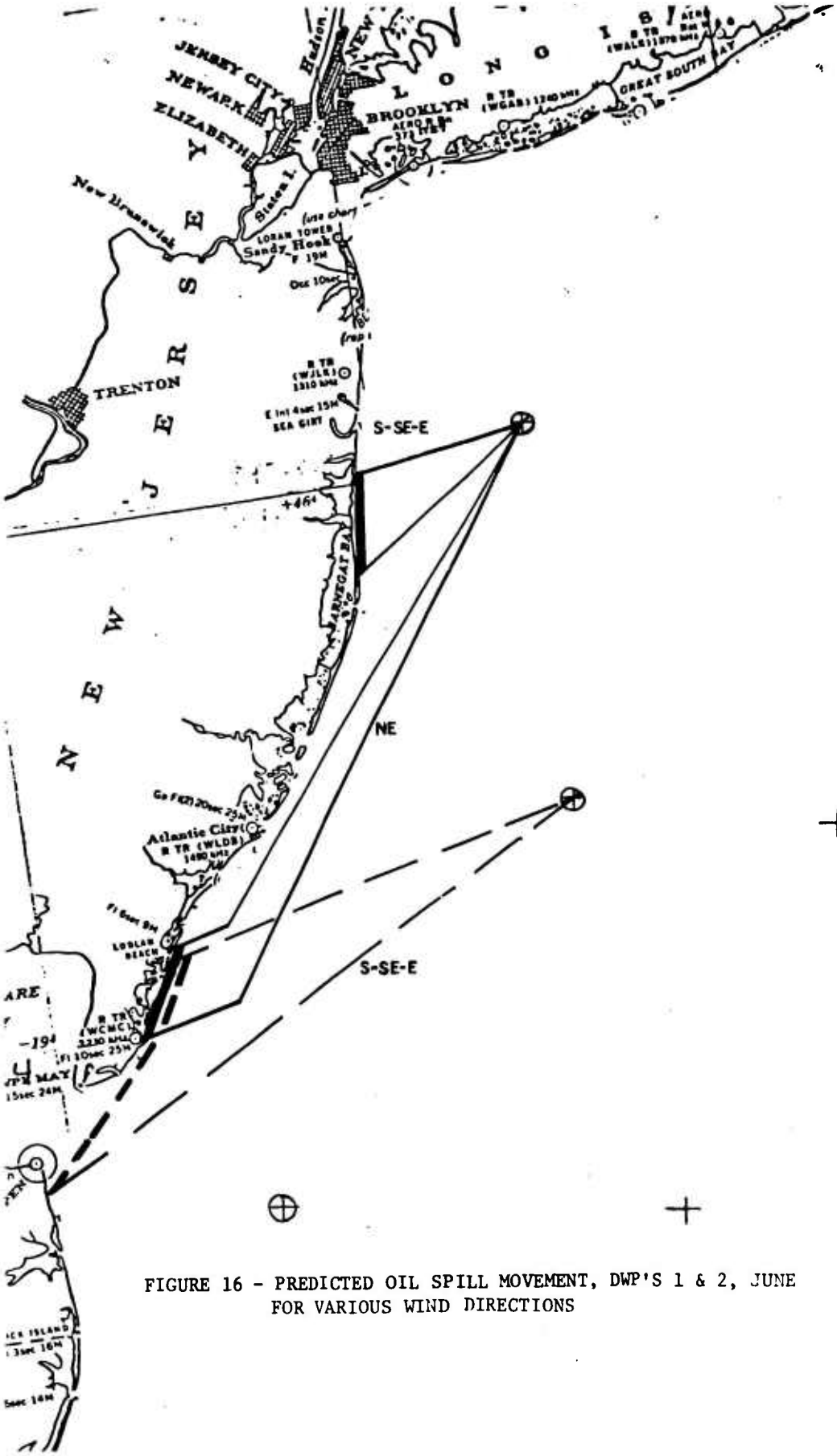


FIGURE 16 - PREDICTED OIL SPILL MOVEMENT, DWP'S 1 & 2, JUNE FOR VARIOUS WIND DIRECTIONS

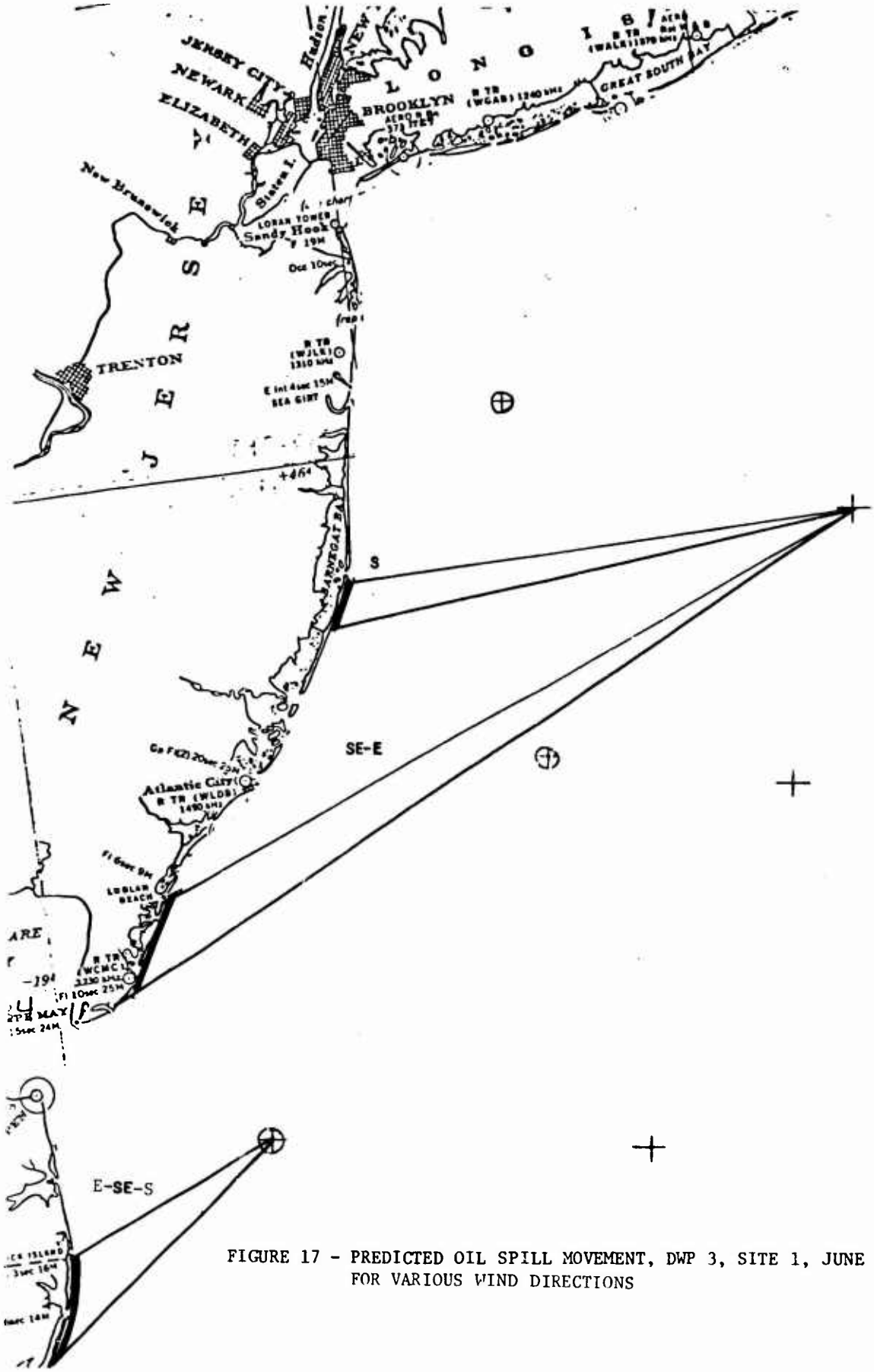


FIGURE 17 - PREDICTED OIL SPILL MOVEMENT, DWP 3, SITE 1, JUNE FOR VARIOUS WIND DIRECTIONS

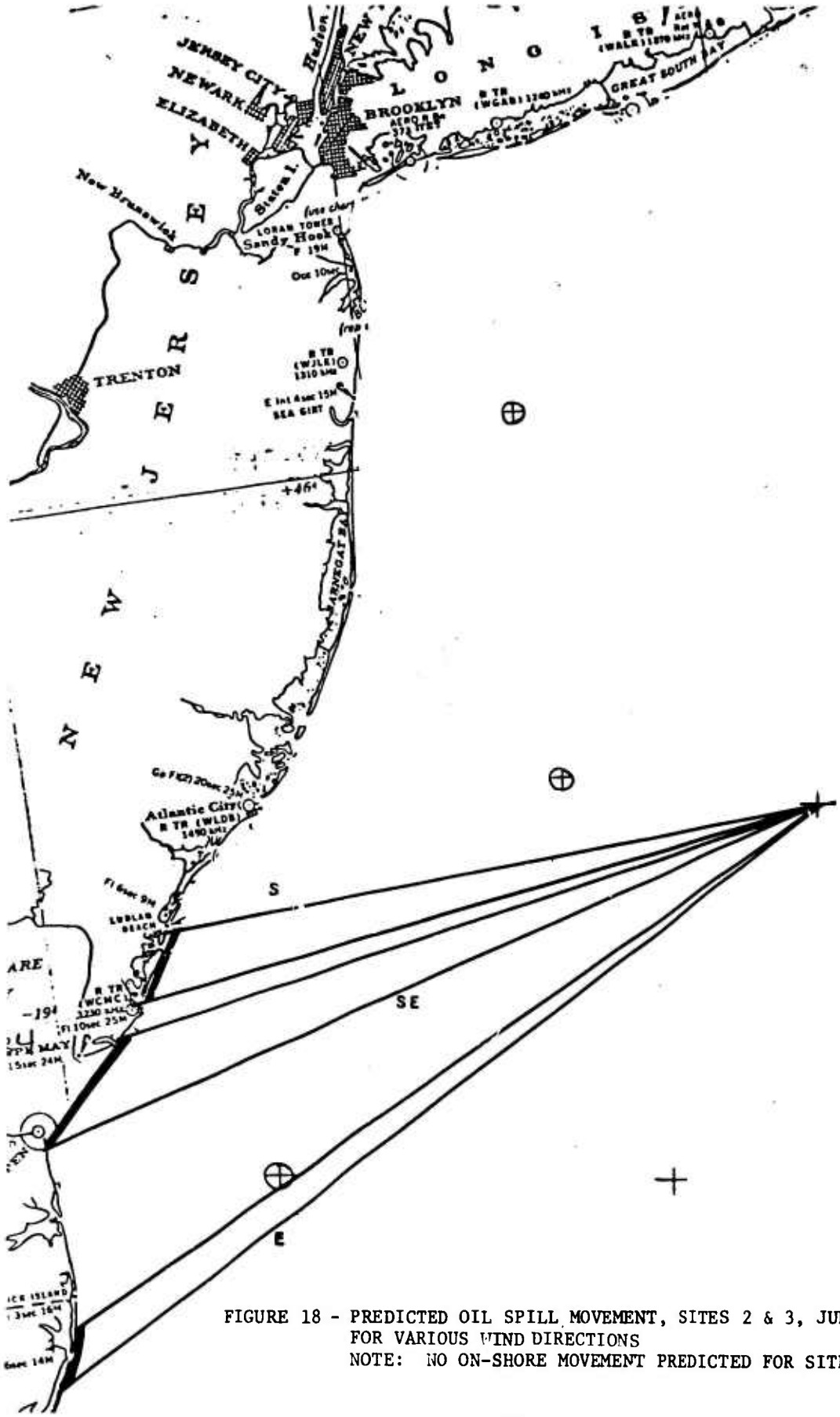


FIGURE 18 - PREDICTED OIL SPILL MOVEMENT, SITES 2 & 3, JUNE FOR VARIOUS WIND DIRECTIONS
NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 3.

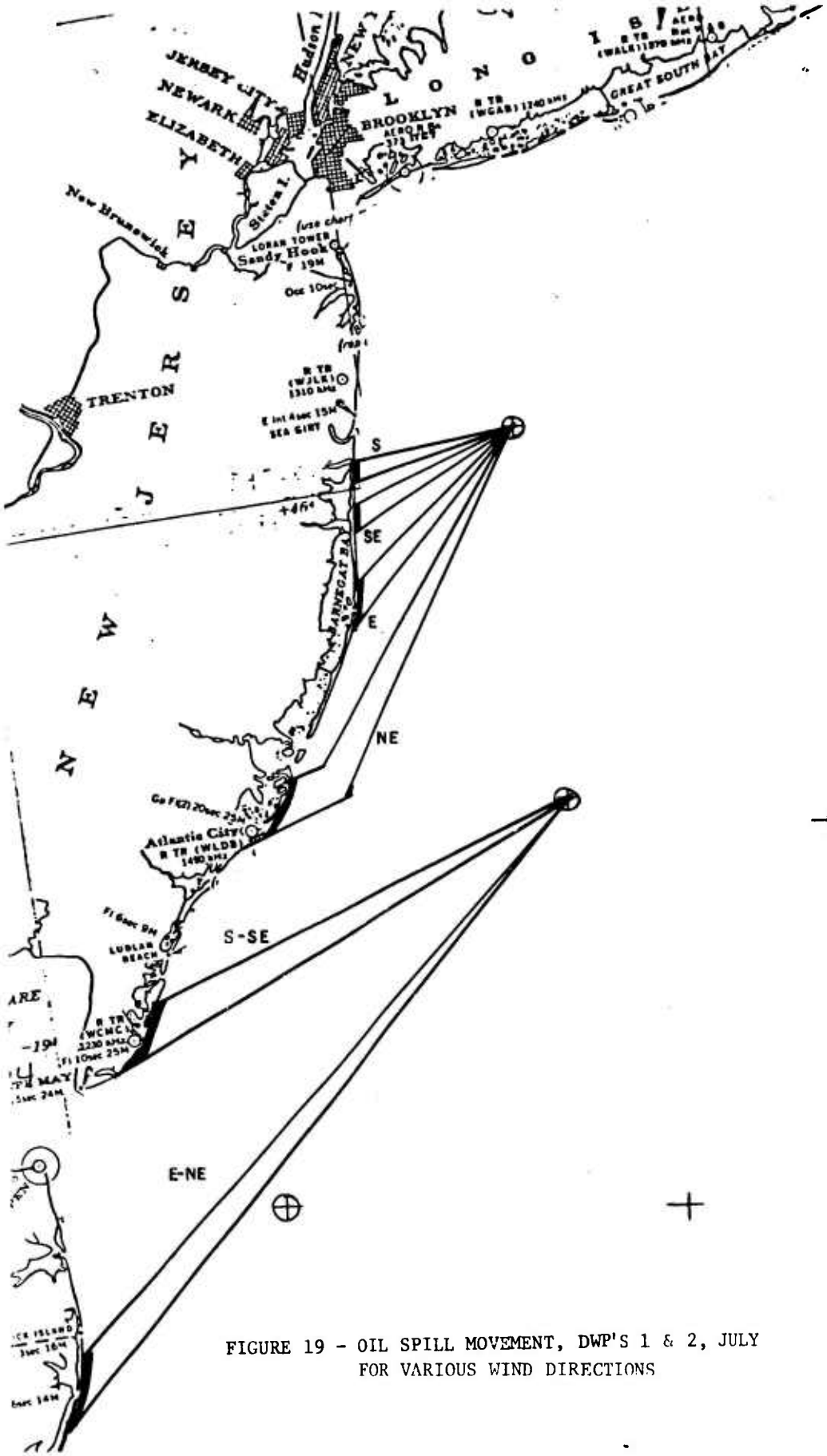


FIGURE 19 - OIL SPILL MOVEMENT, DWP'S 1 & 2, JULY
FOR VARIOUS WIND DIRECTIONS

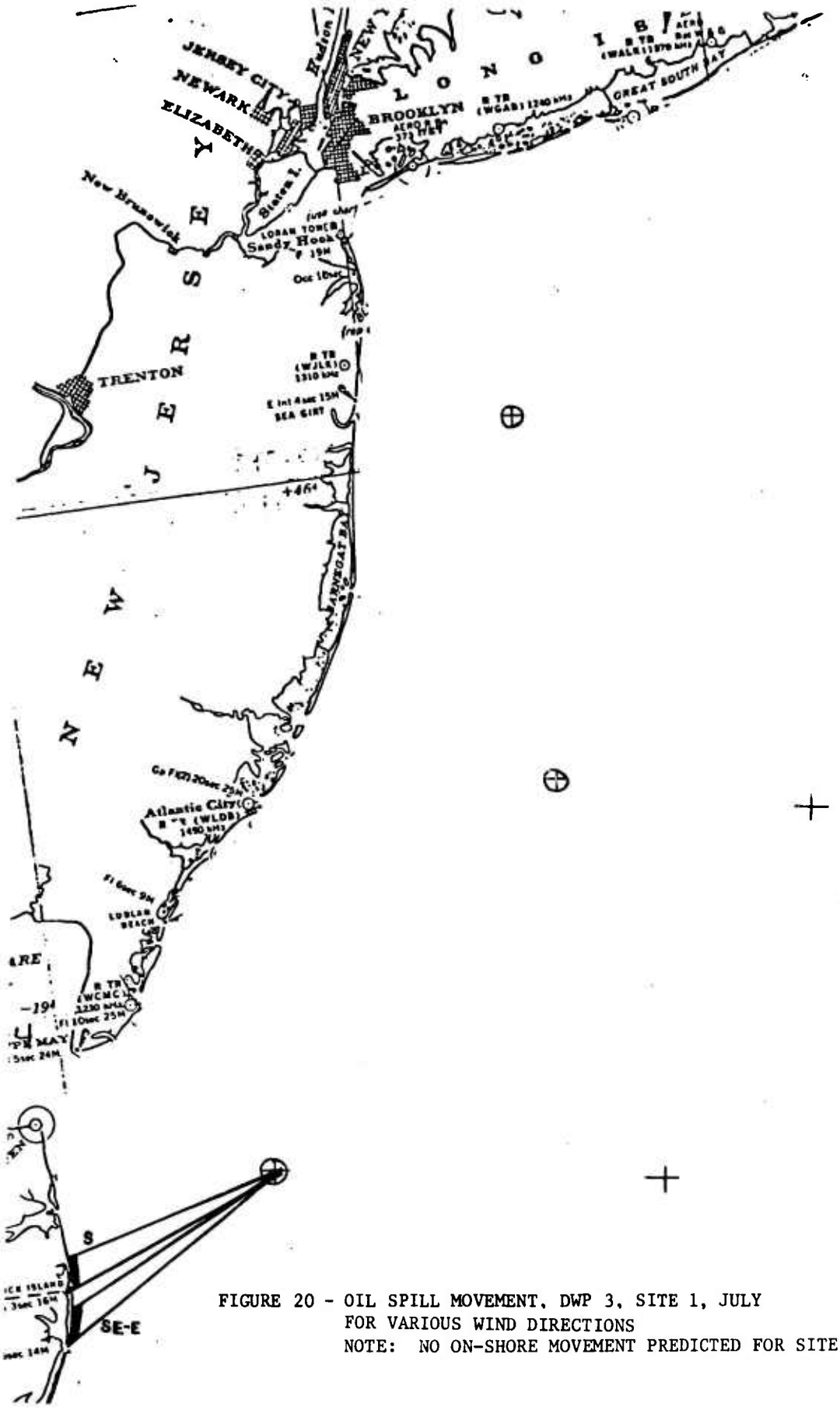


FIGURE 20 - OIL SPILL MOVEMENT, DWP 3, SITE 1, JULY
FOR VARIOUS WIND DIRECTIONS
NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 1.

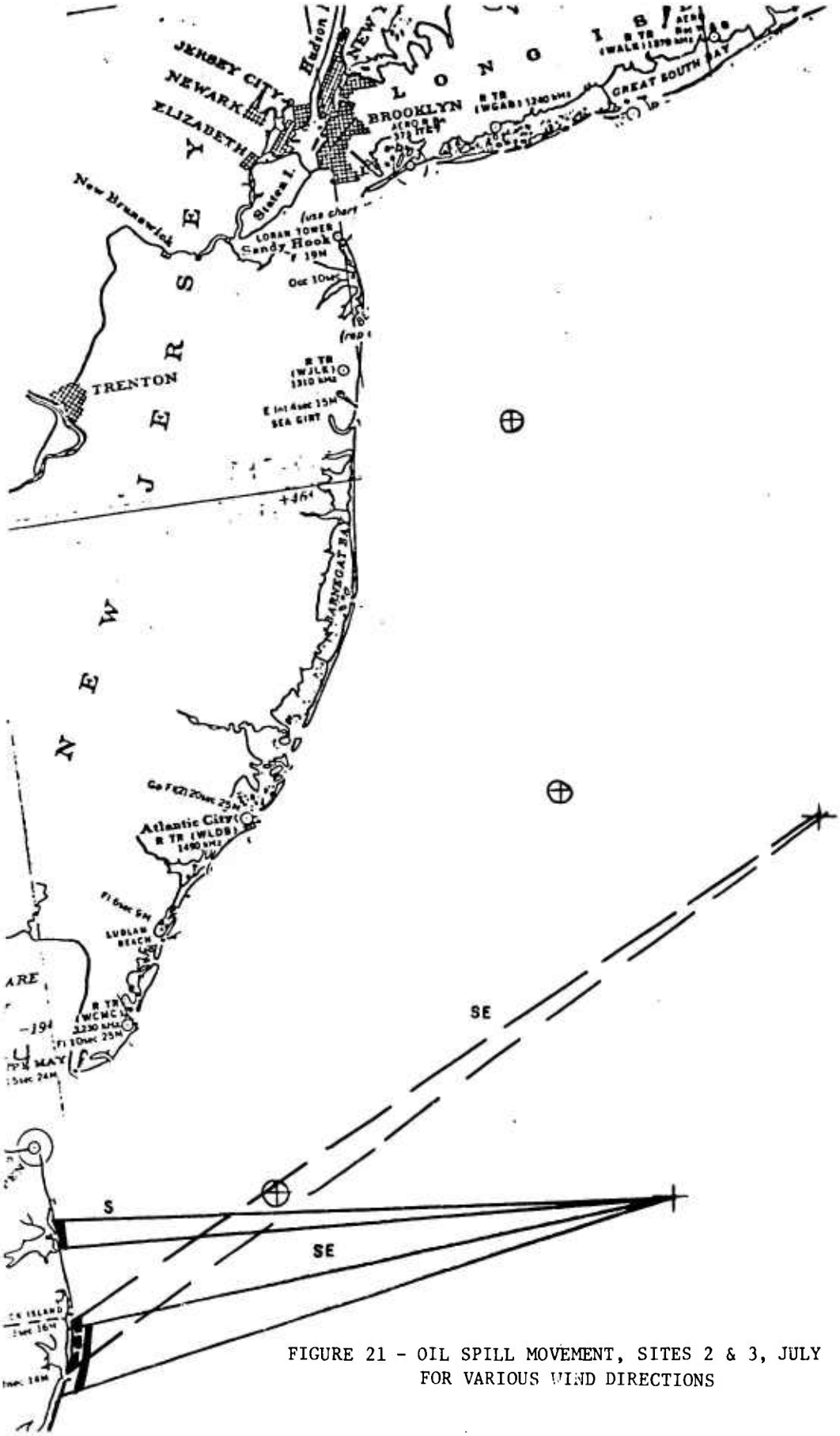


FIGURE 21 - OIL SPILL MOVEMENT, SITES 2 & 3, JULY FOR VARIOUS WIND DIRECTIONS

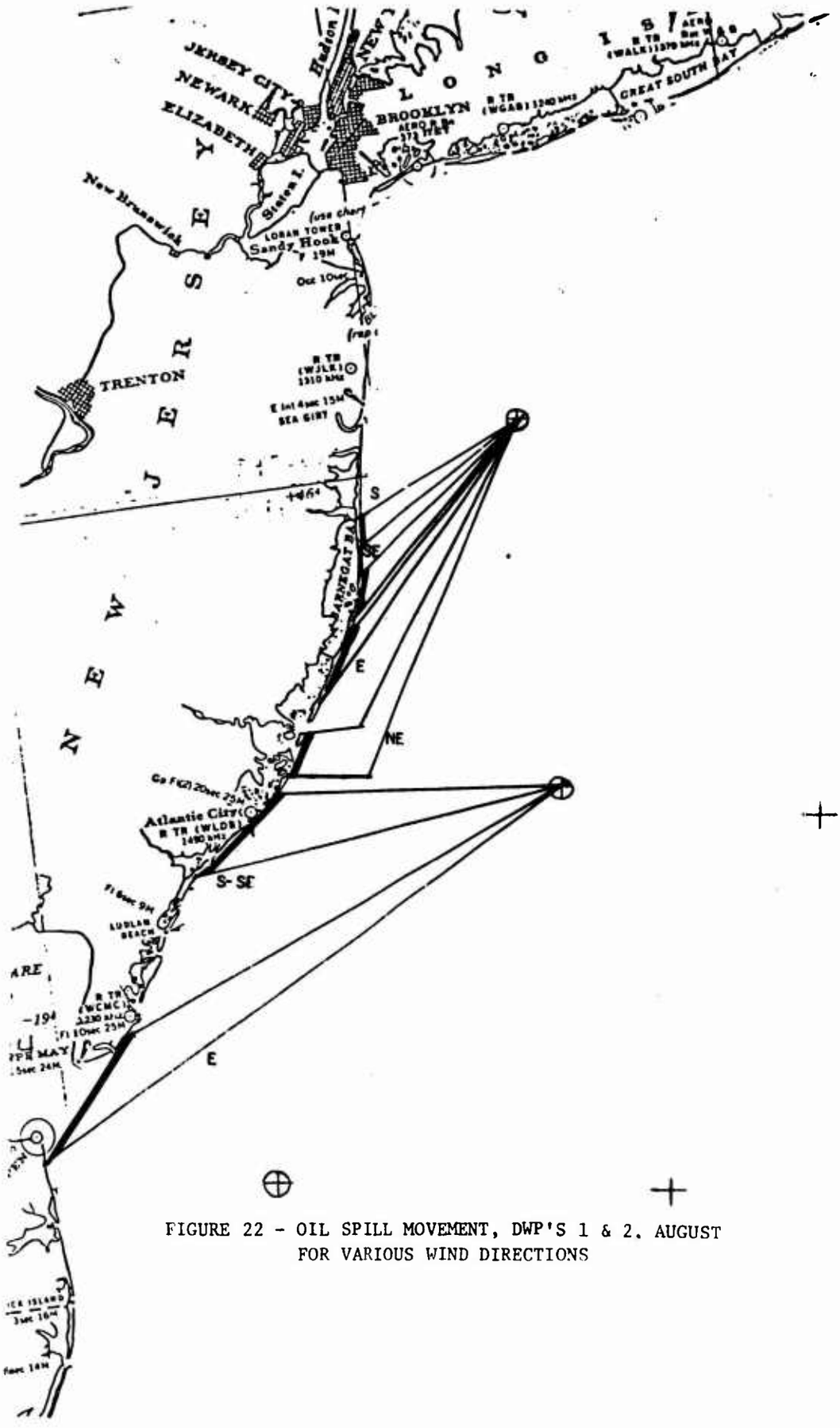


FIGURE 22 - OIL SPILL MOVEMENT, DWP'S 1 & 2, AUGUST FOR VARIOUS WIND DIRECTIONS

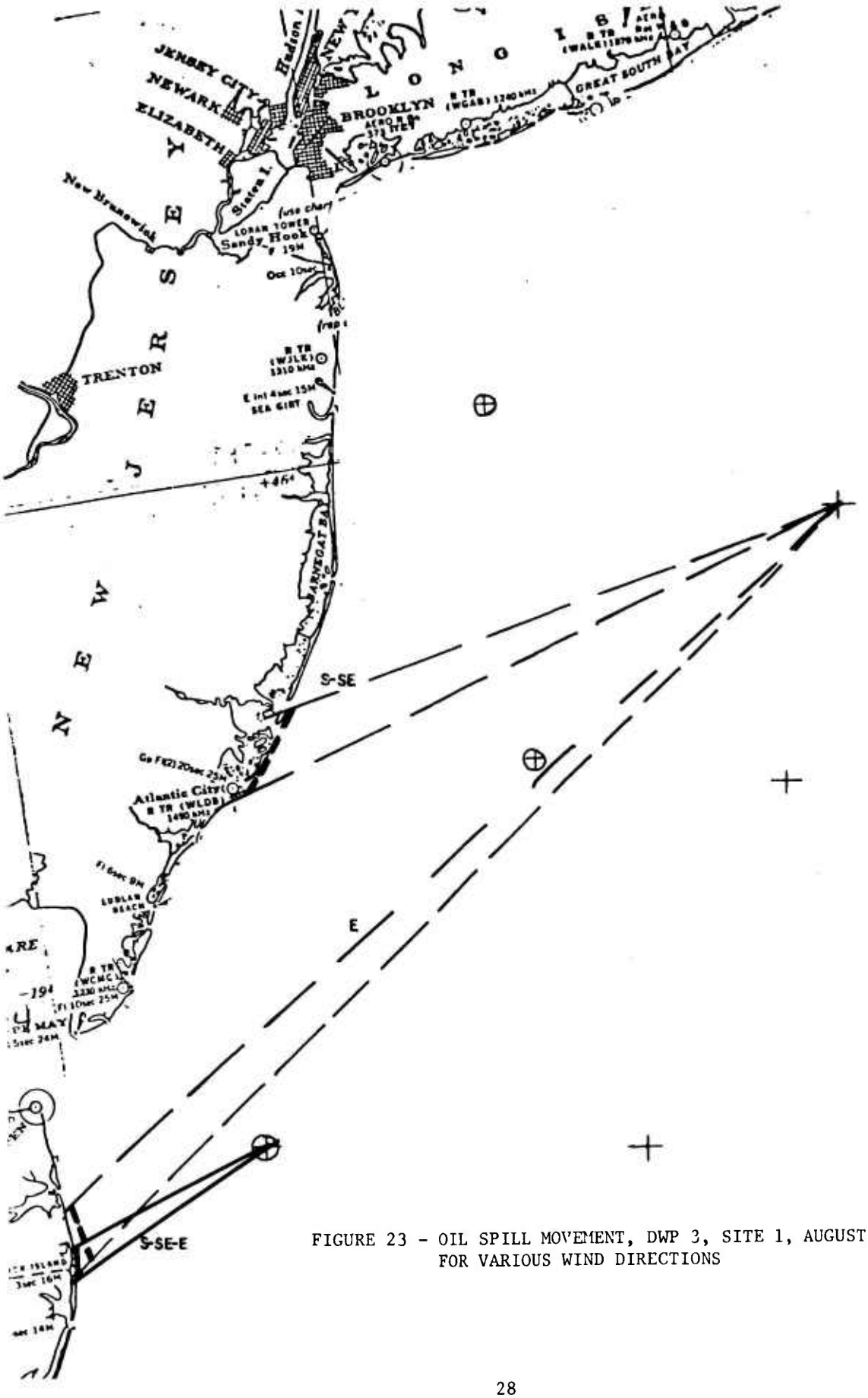


FIGURE 23 - OIL SPILL MOVEMENT, DWP 3, SITE 1, AUGUST FOR VARIOUS WIND DIRECTIONS

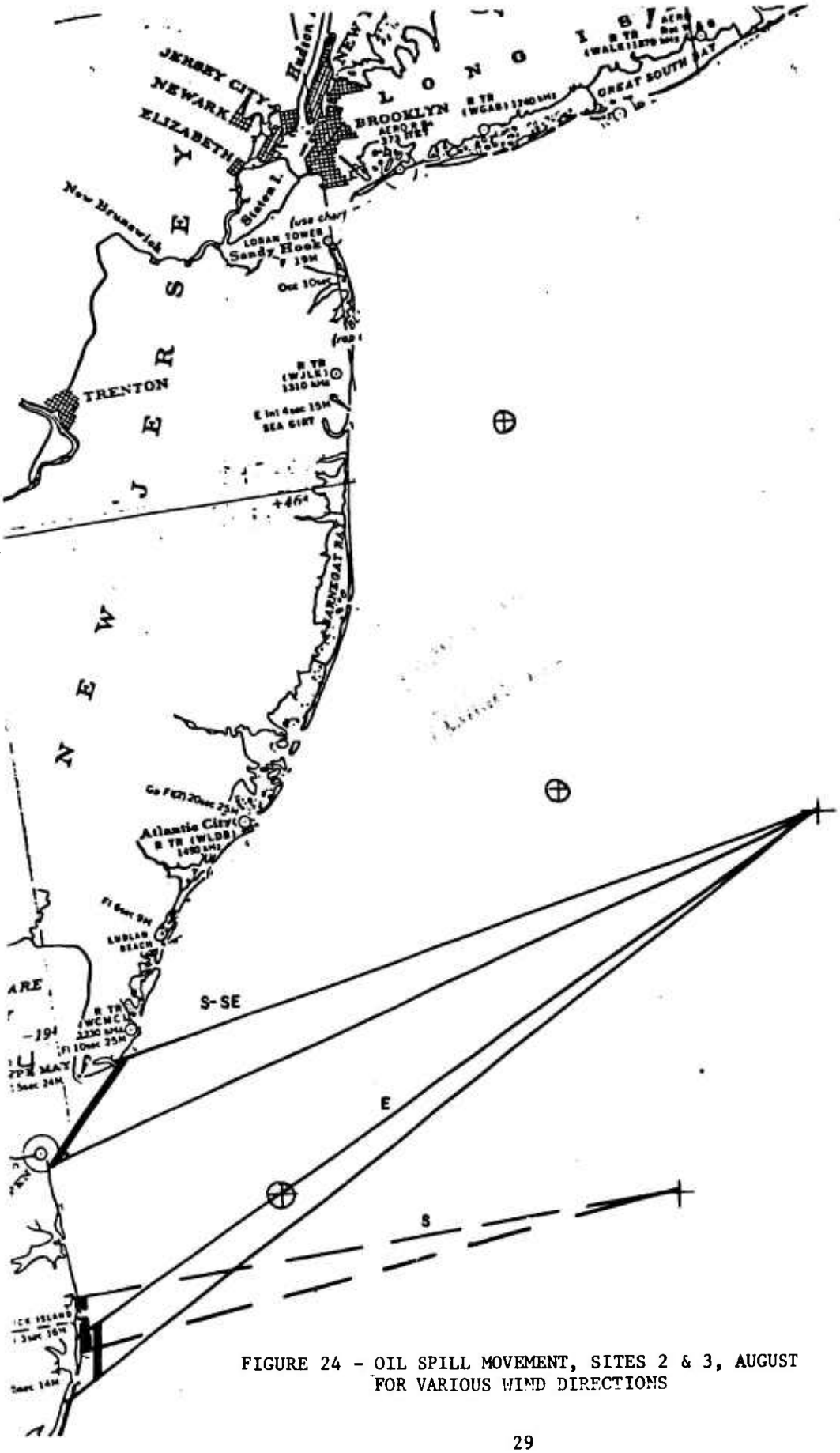


FIGURE 24 - OIL SPILL MOVEMENT, SITES 2 & 3, AUGUST FOR VARIOUS WIND DIRECTIONS

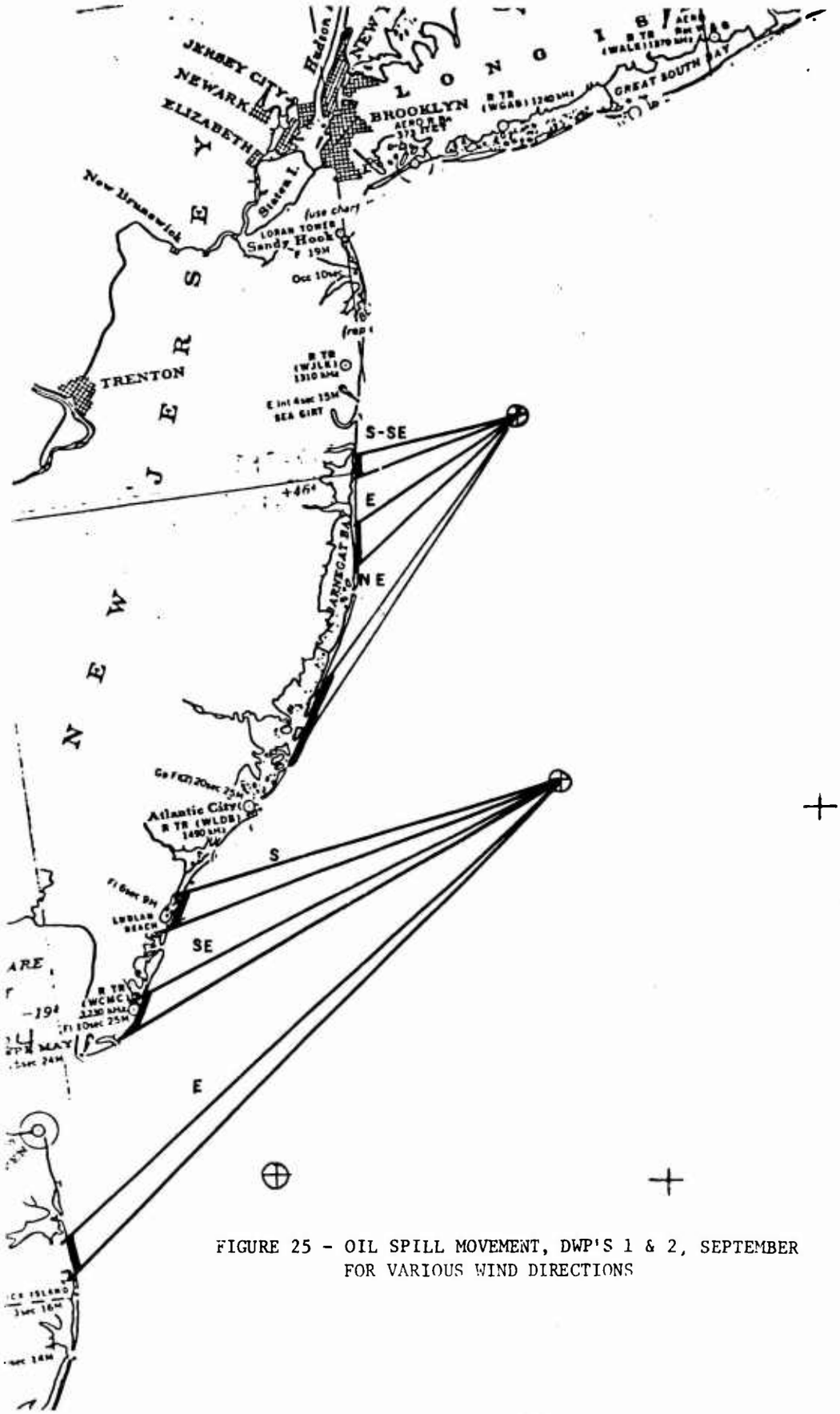


FIGURE 25 - OIL SPILL MOVEMENT, DWP'S 1 & 2, SEPTEMBER
FOR VARIOUS WIND DIRECTIONS

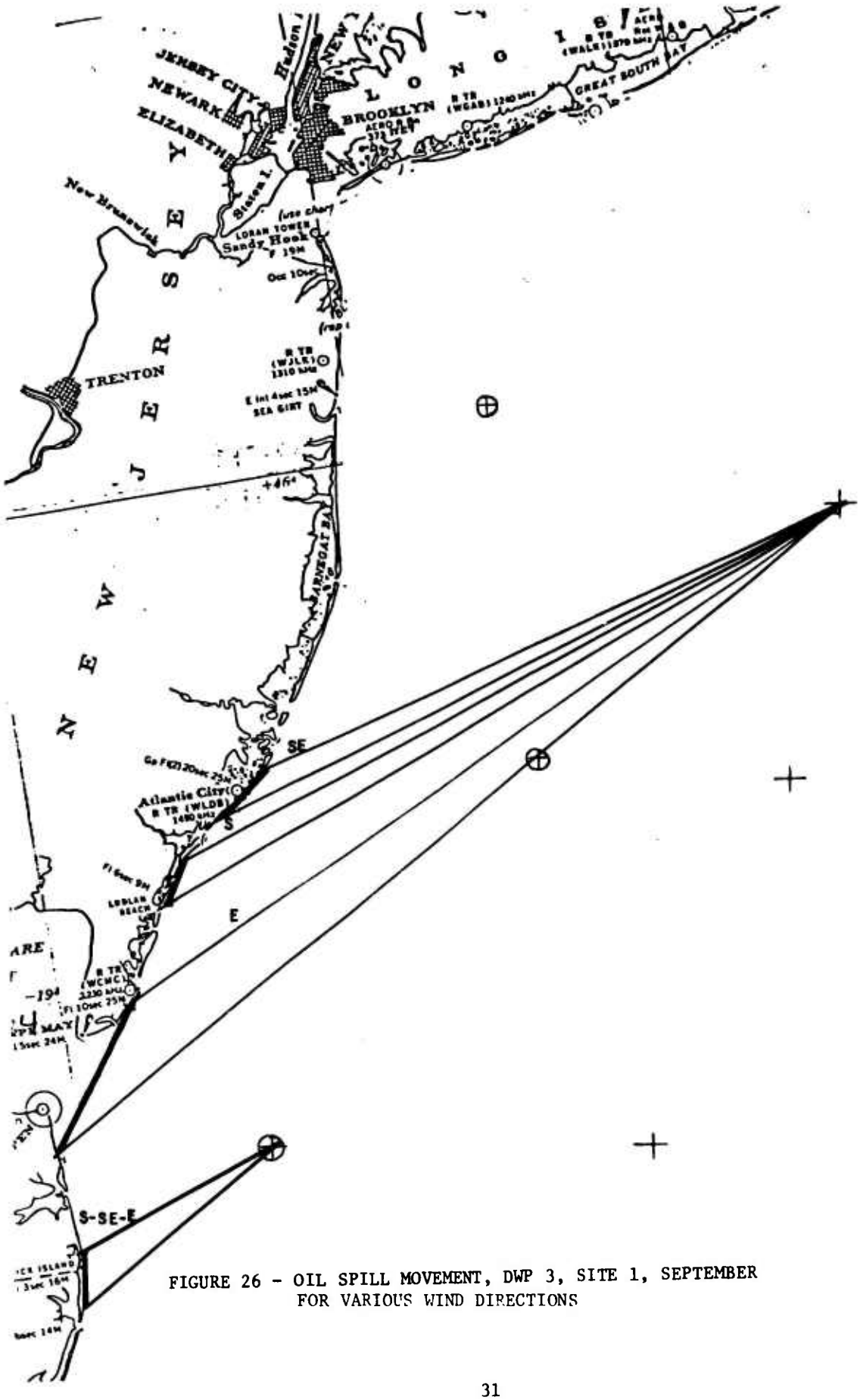


FIGURE 26 - OIL SPILL MOVEMENT, DWP 3, SITE 1, SEPTEMBER FOR VARIOUS WIND DIRECTIONS

FIGURE 27 - OIL SPILL MOVEMENT, SITES 2 & 3, SEPTEMBER
FOR VARIOUS WIND DIRECTIONS
NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 3.

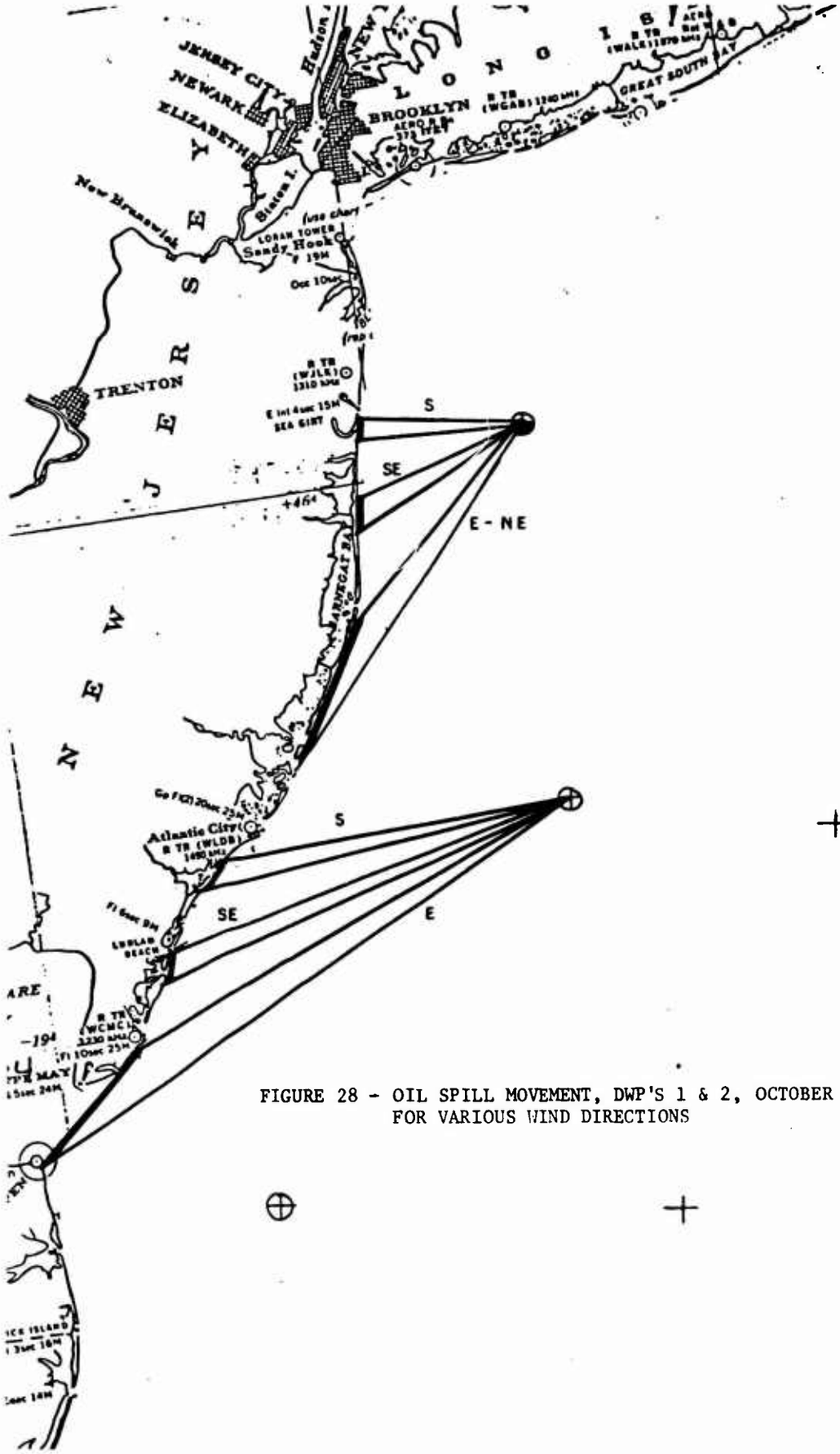


FIGURE 28 - OIL SPILL MOVEMENT, DWP'S 1 & 2, OCTOBER FOR VARIOUS WIND DIRECTIONS

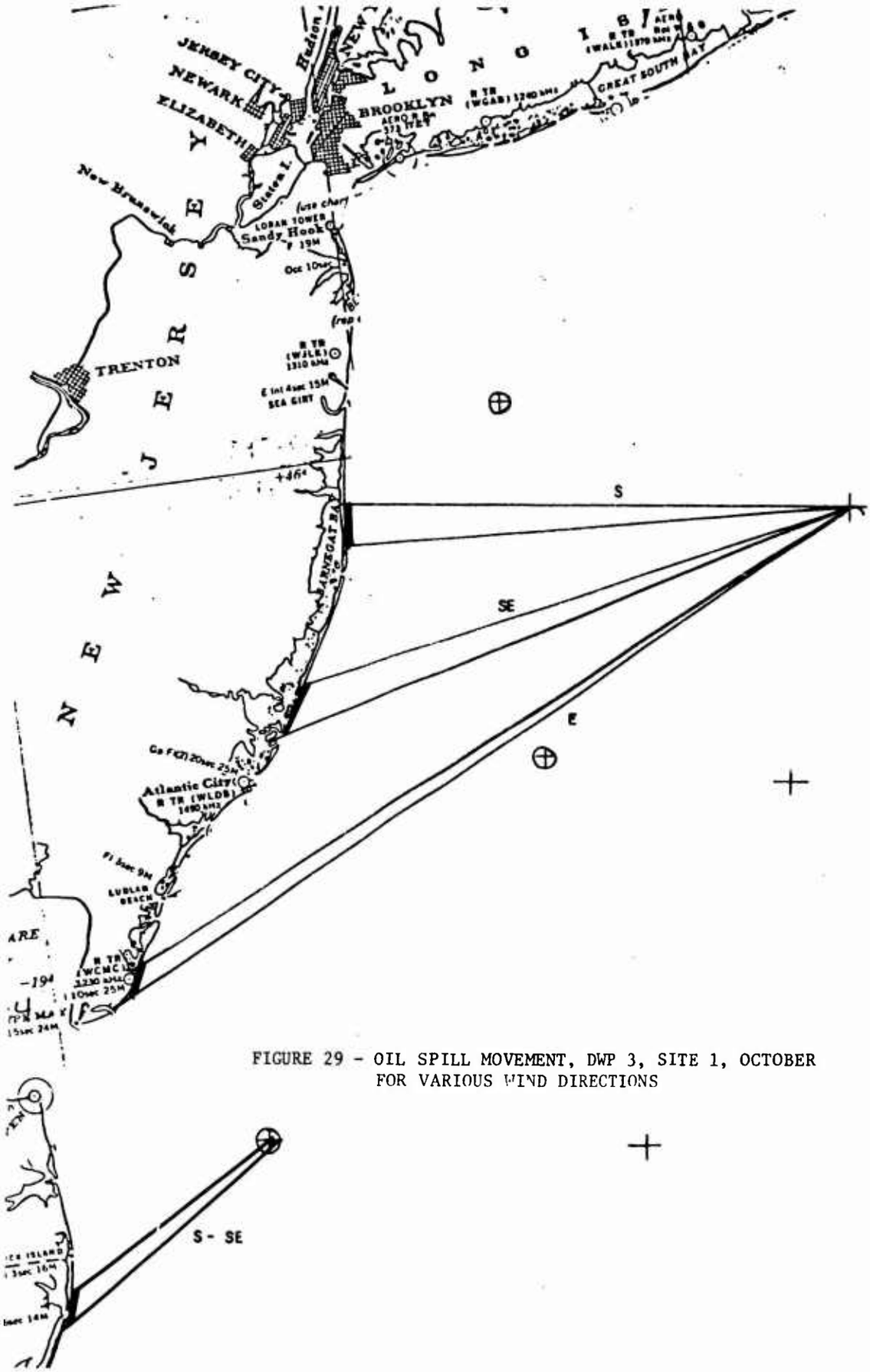


FIGURE 29 - OIL SPILL MOVEMENT, DWP 3, SITE 1, OCTOBER FOR VARIOUS WIND DIRECTIONS

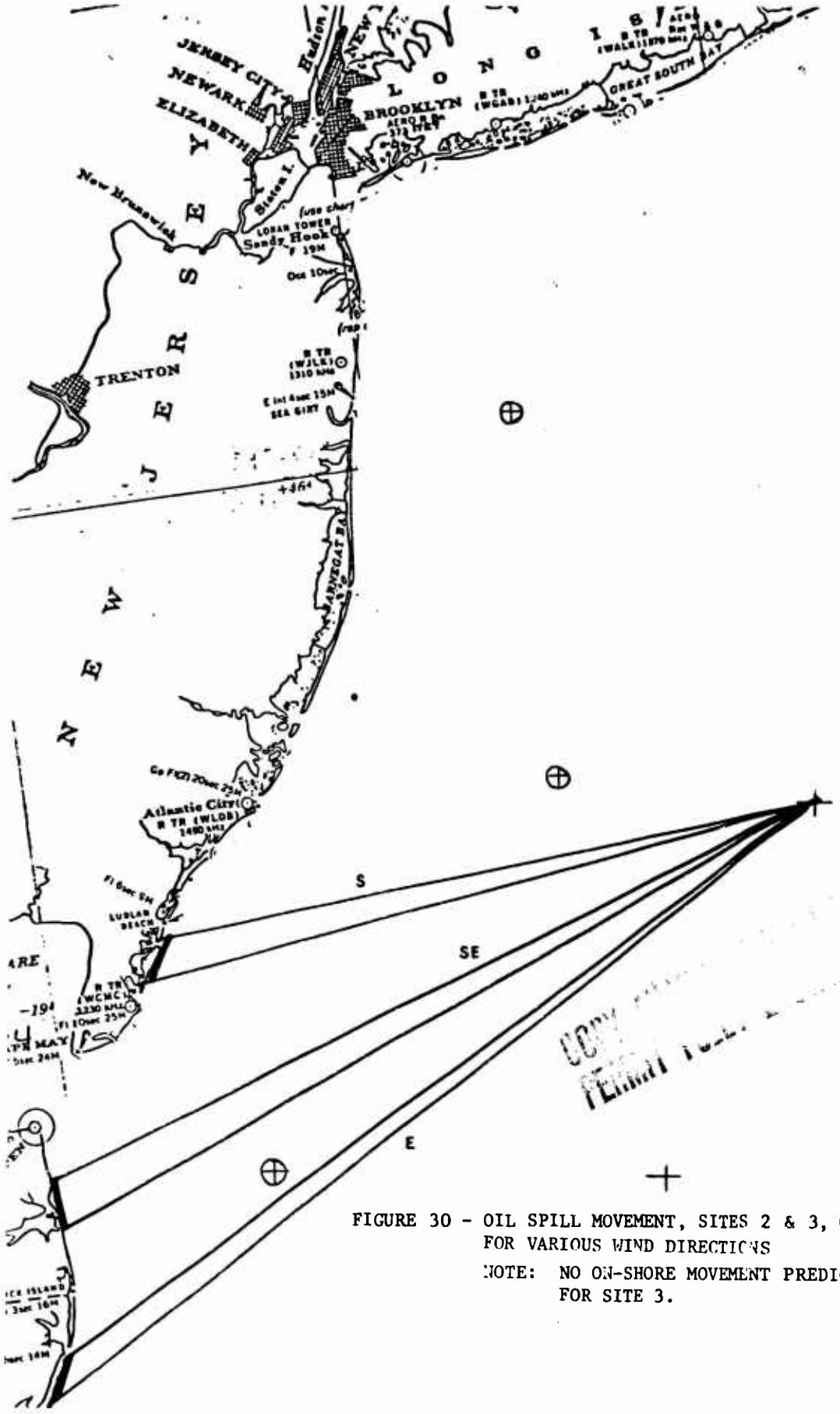


FIGURE 30 - OIL SPILL MOVEMENT, SITES 2 & 3, OCTOBER FOR VARIOUS WIND DIRECTIONS

NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 3.

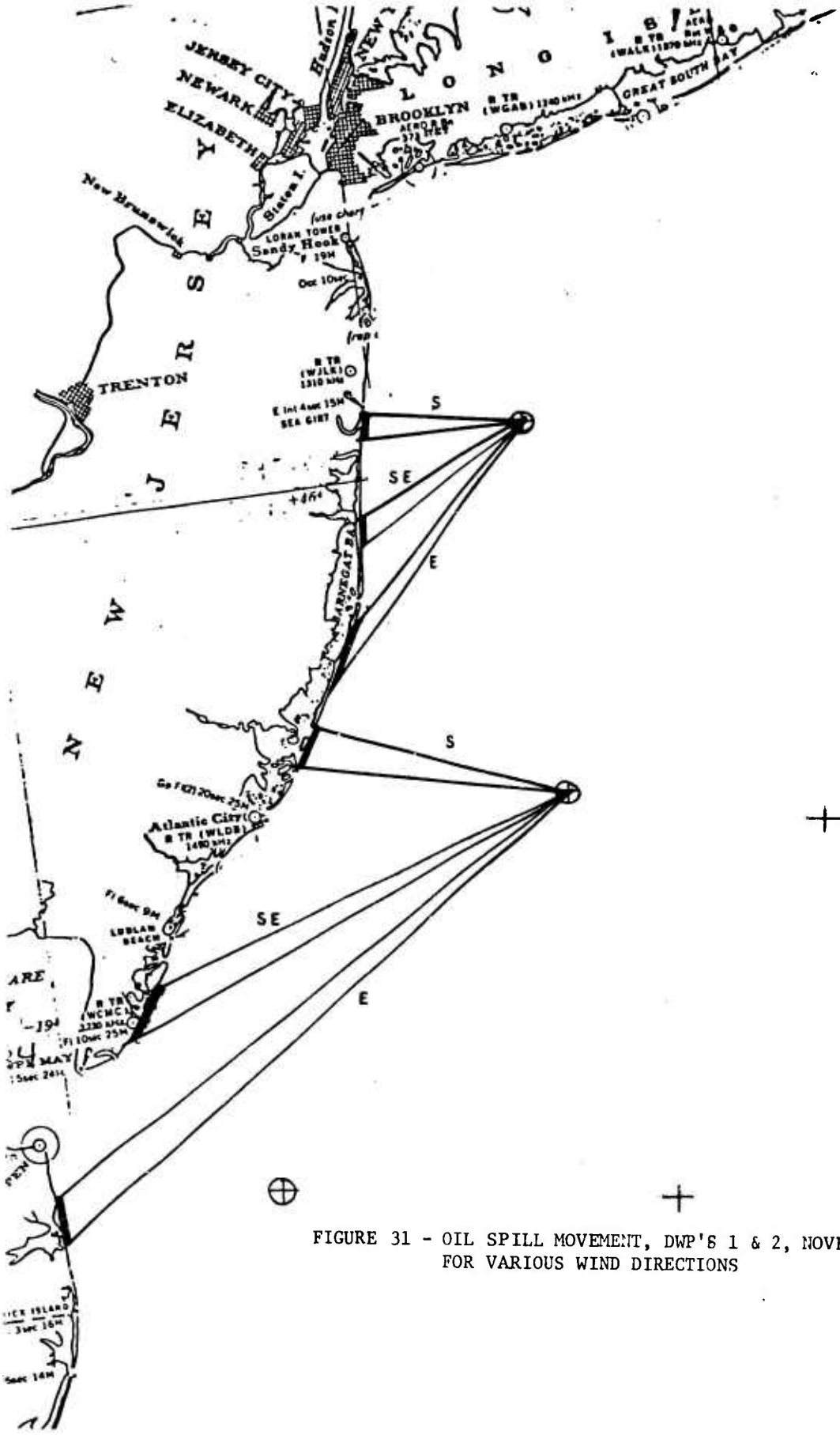


FIGURE 31 - OIL SPILL MOVEMENT, DWP'S 1 & 2, NOVEMBER FOR VARIOUS WIND DIRECTIONS

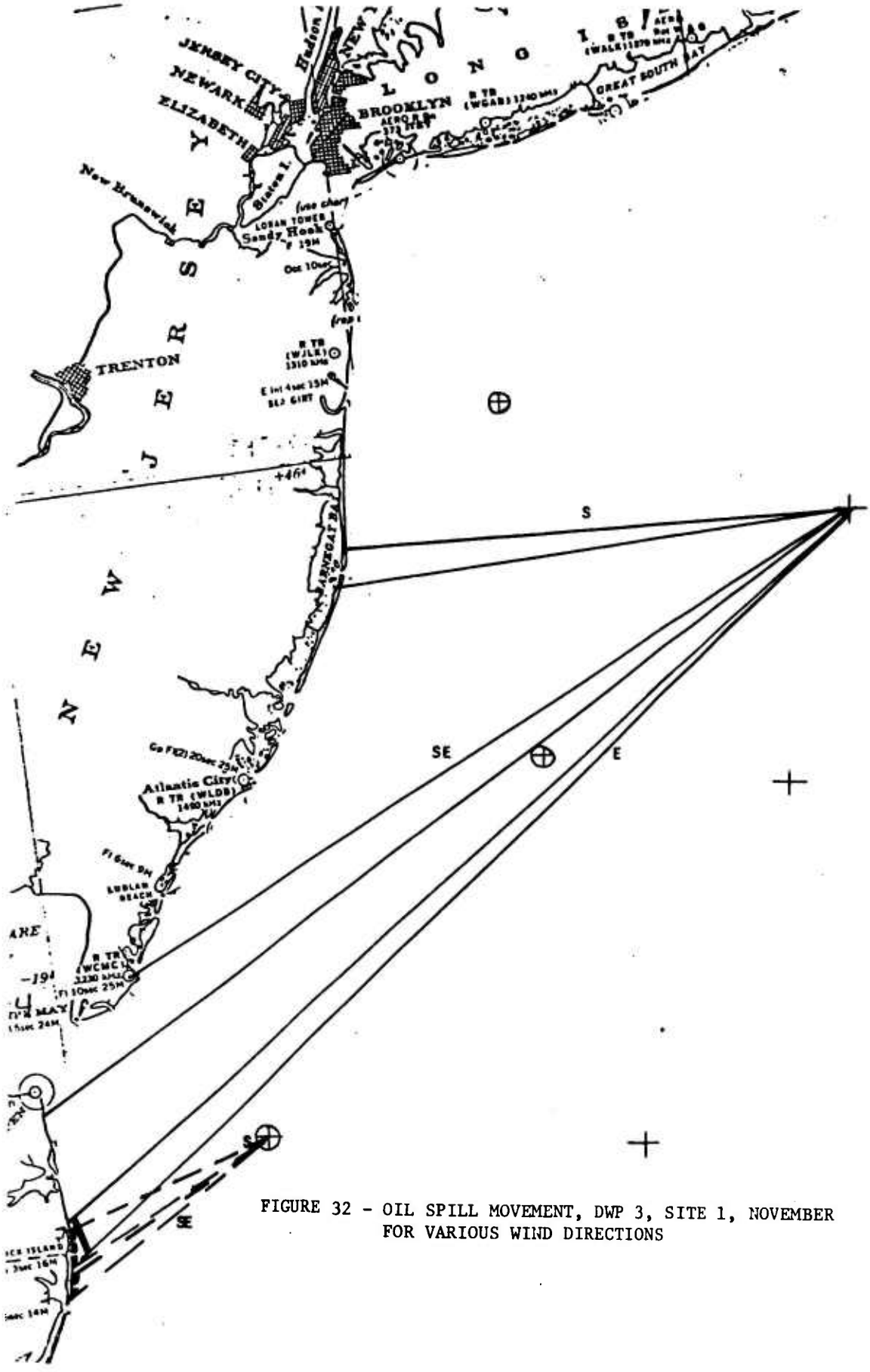


FIGURE 32 - OIL SPILL MOVEMENT, DWP 3, SITE 1, NOVEMBER FOR VARIOUS WIND DIRECTIONS

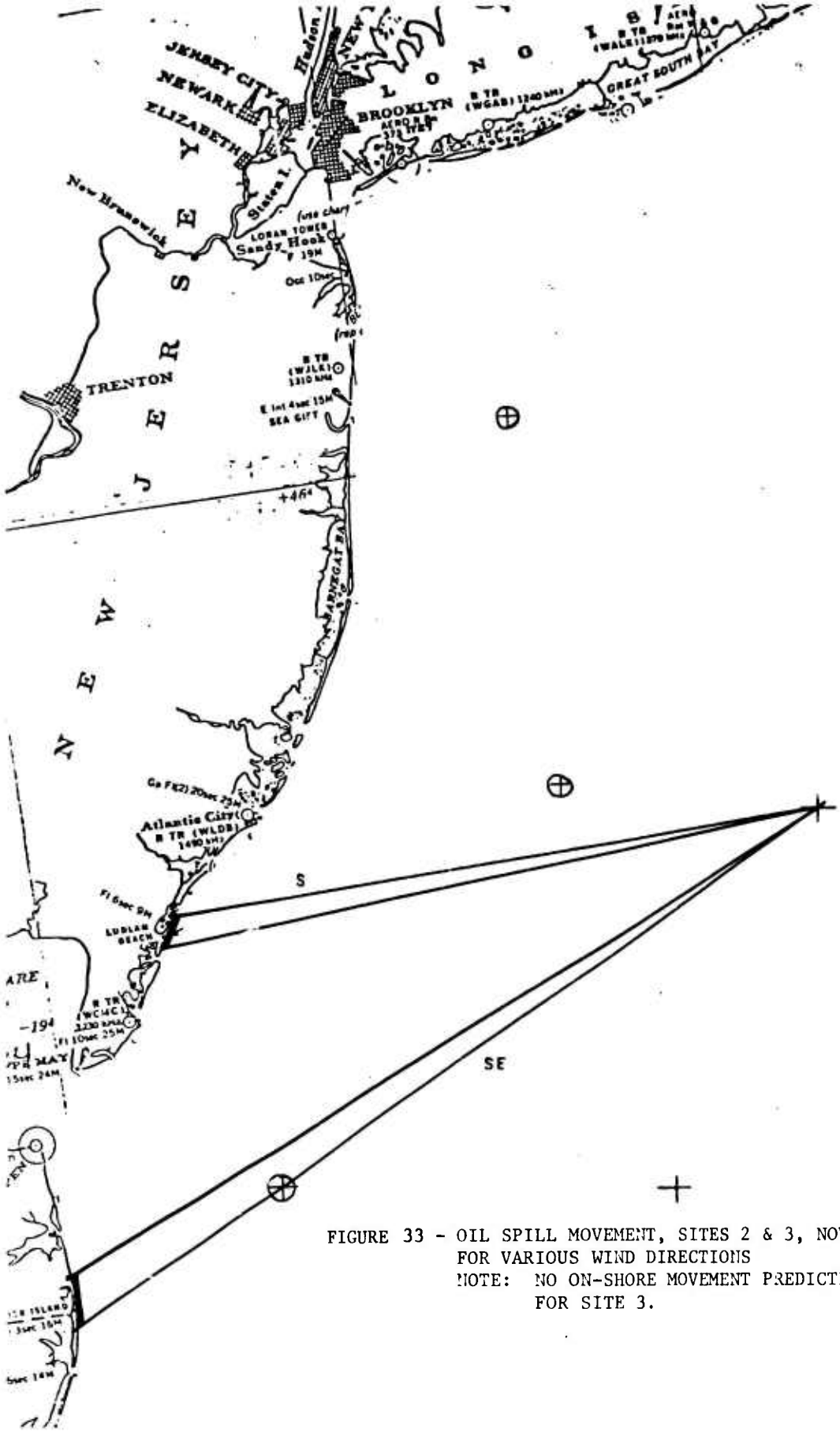


FIGURE 33 - OIL SPILL MOVEMENT, SITES 2 & 3, NOVEMBER FOR VARIOUS WIND DIRECTIONS
NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 3.

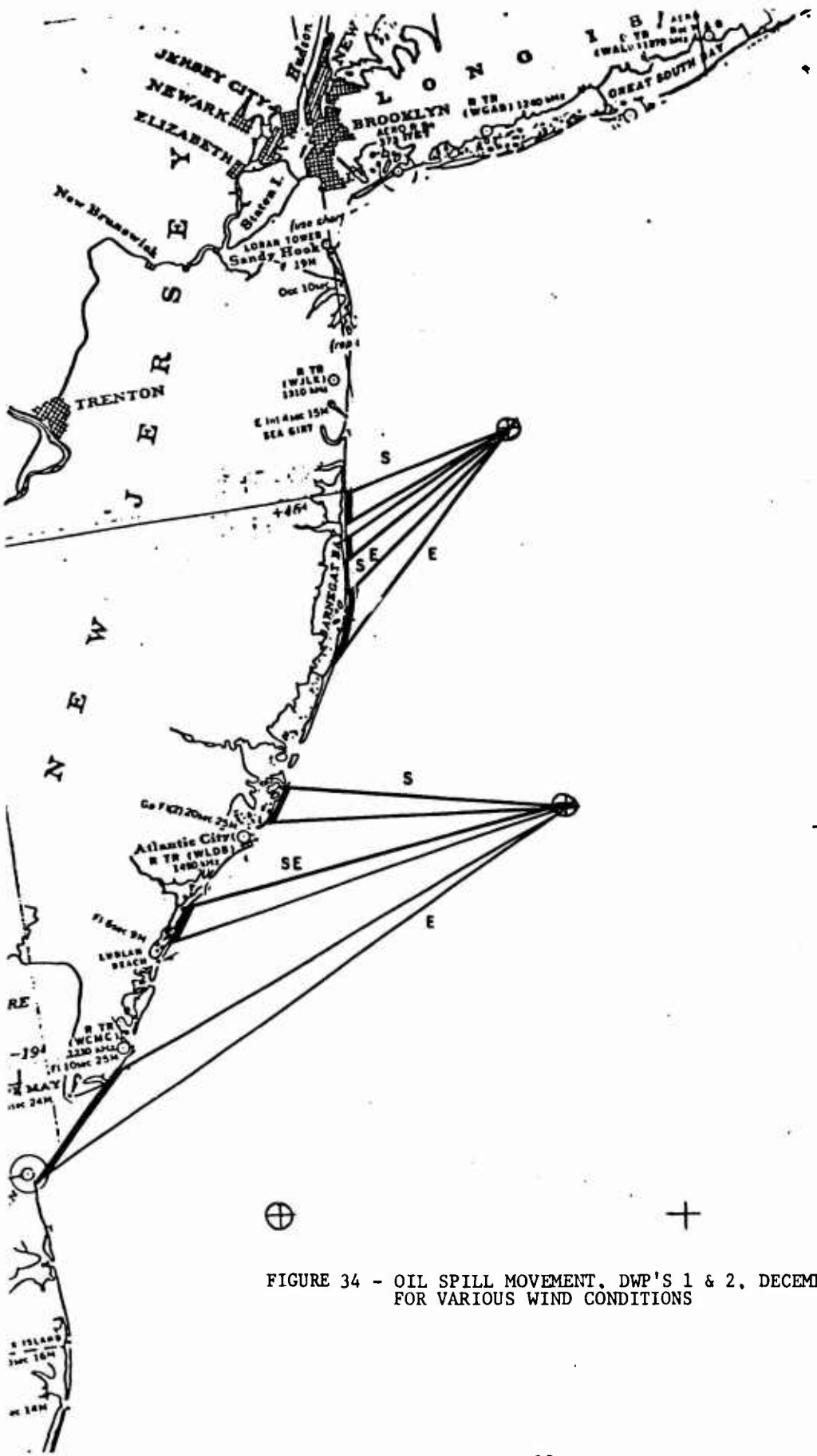


FIGURE 34 - OIL SPILL MOVEMENT, DWP'S 1 & 2, DECEMBER FOR VARIOUS WIND CONDITIONS

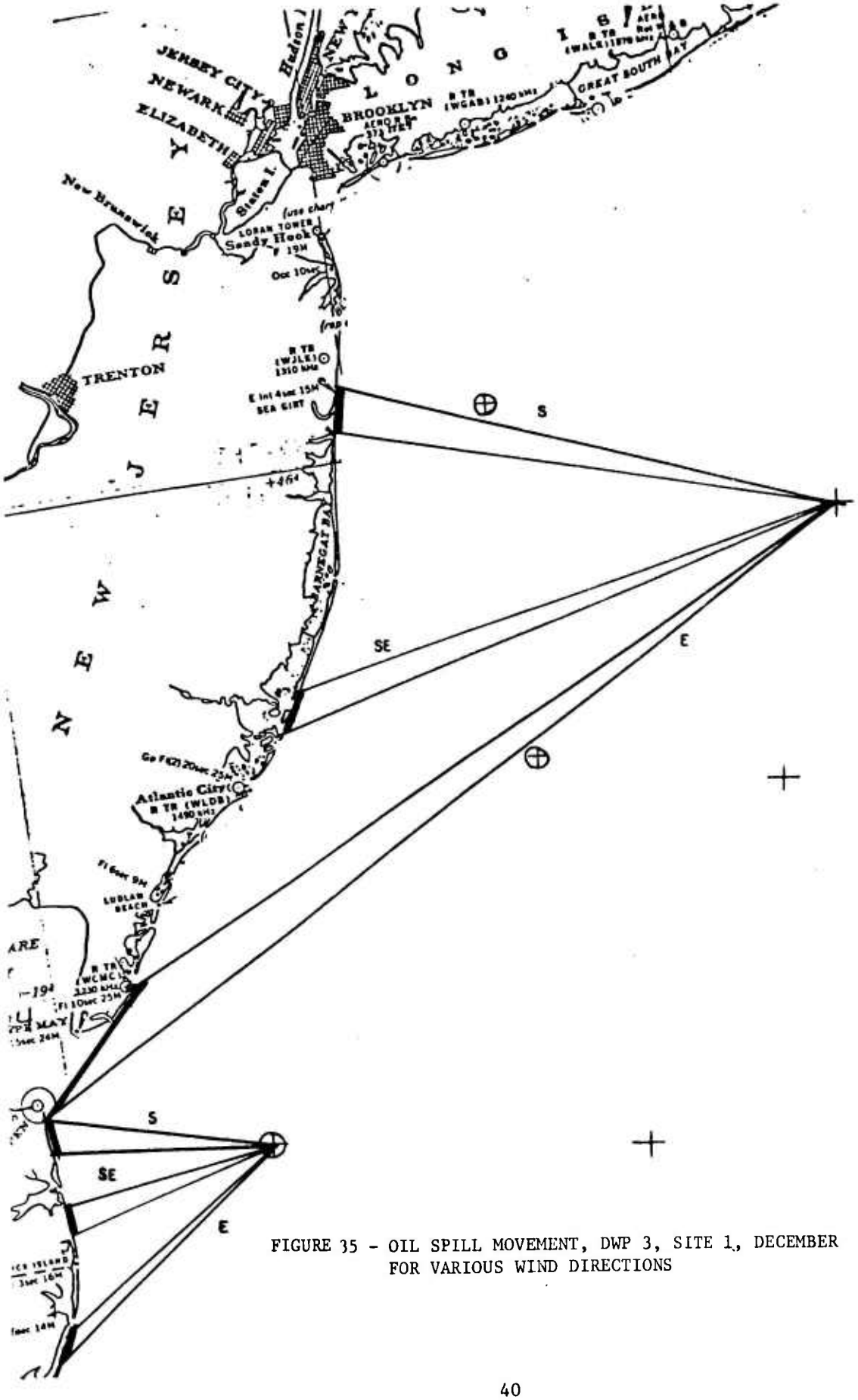


FIGURE 35 - OIL SPILL MOVEMENT, DWP 3, SITE 1, DECEMBER FOR VARIOUS WIND DIRECTIONS

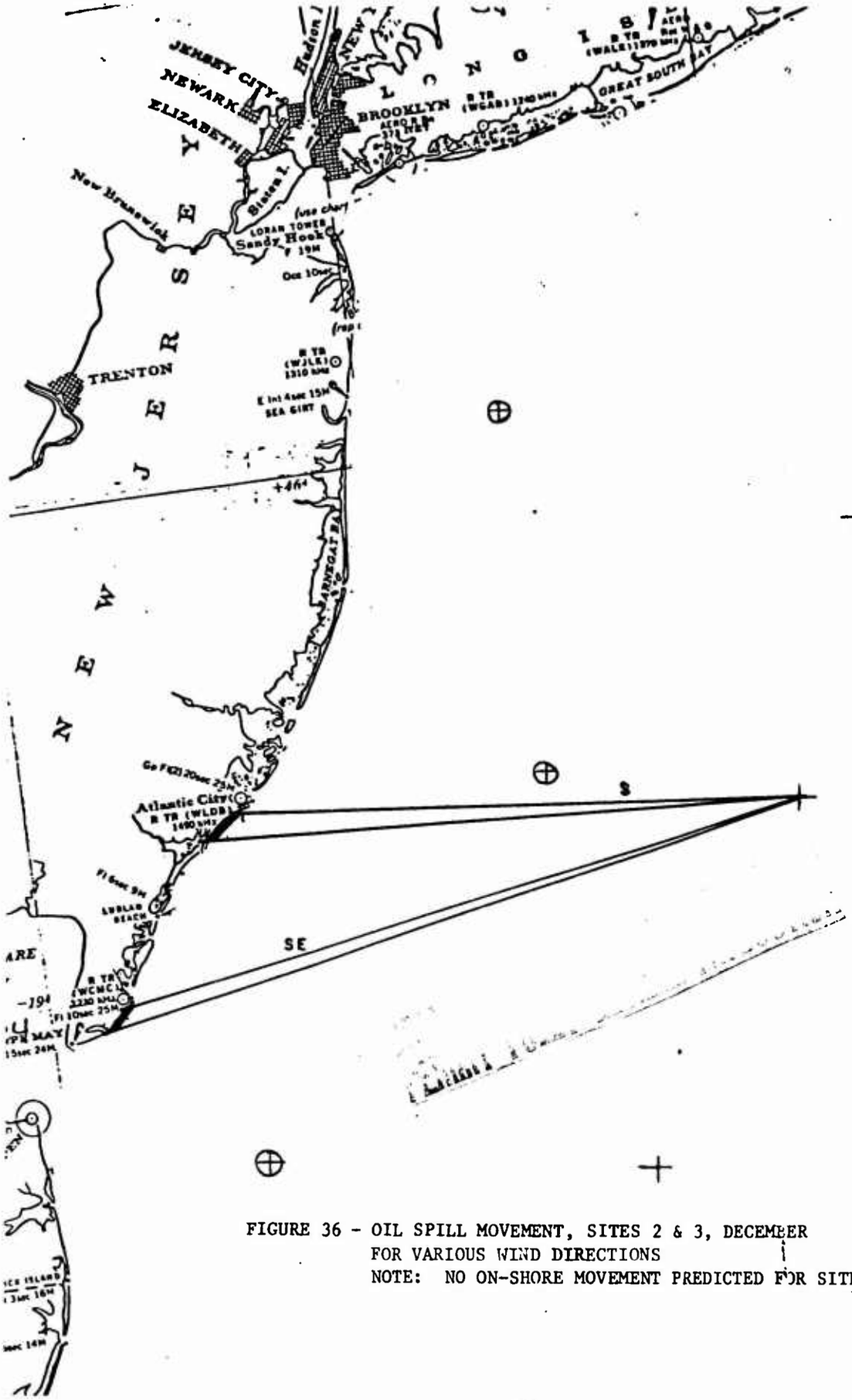


FIGURE 36 - OIL SPILL MOVEMENT, SITES 2 & 3, DECEMBER
FOR VARIOUS WIND DIRECTIONS
NOTE: NO ON-SHORE MOVEMENT PREDICTED FOR SITE 3.

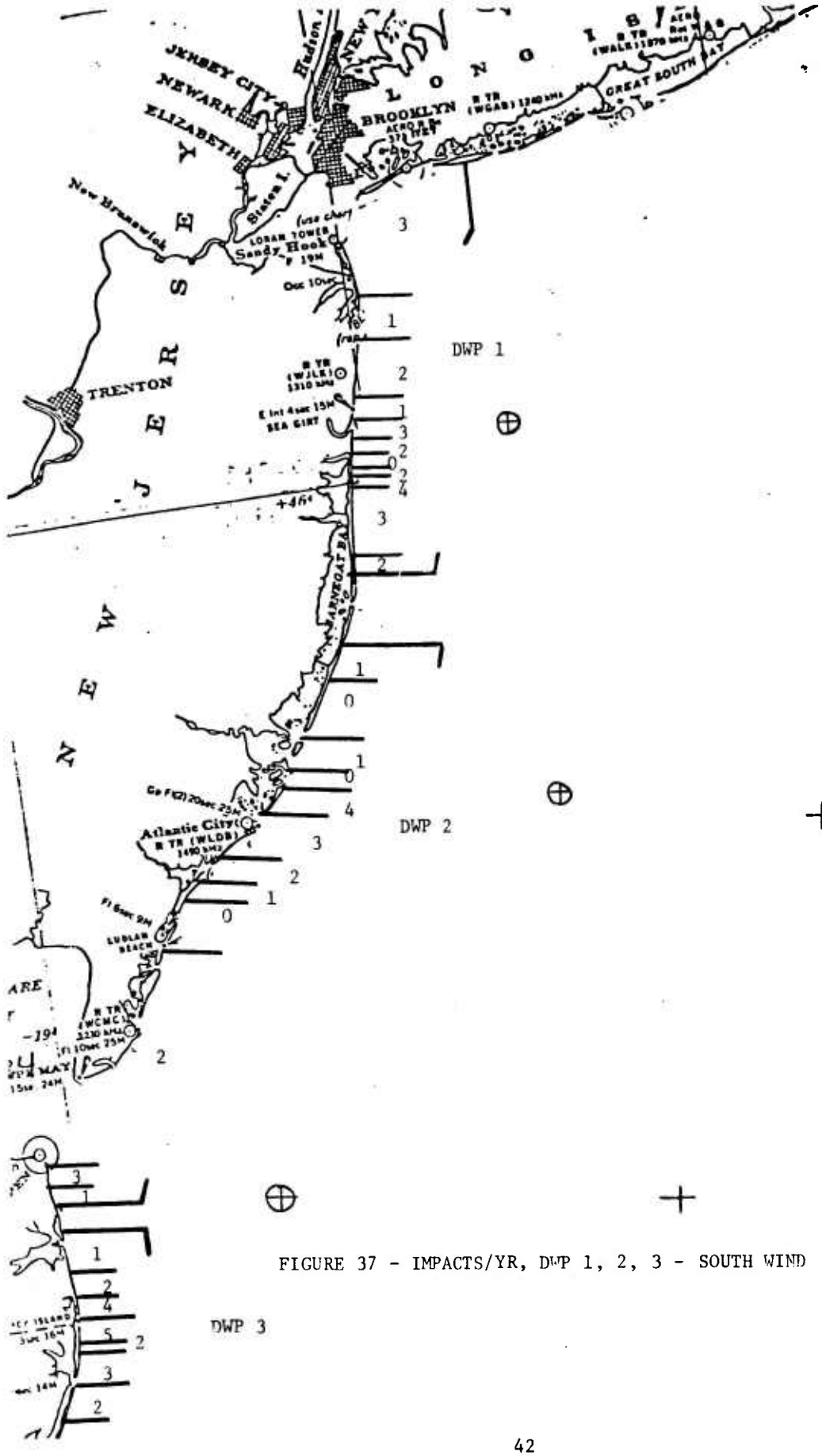


FIGURE 37 - IMPACTS/YR, DWP 1, 2, 3 - SOUTH WIND

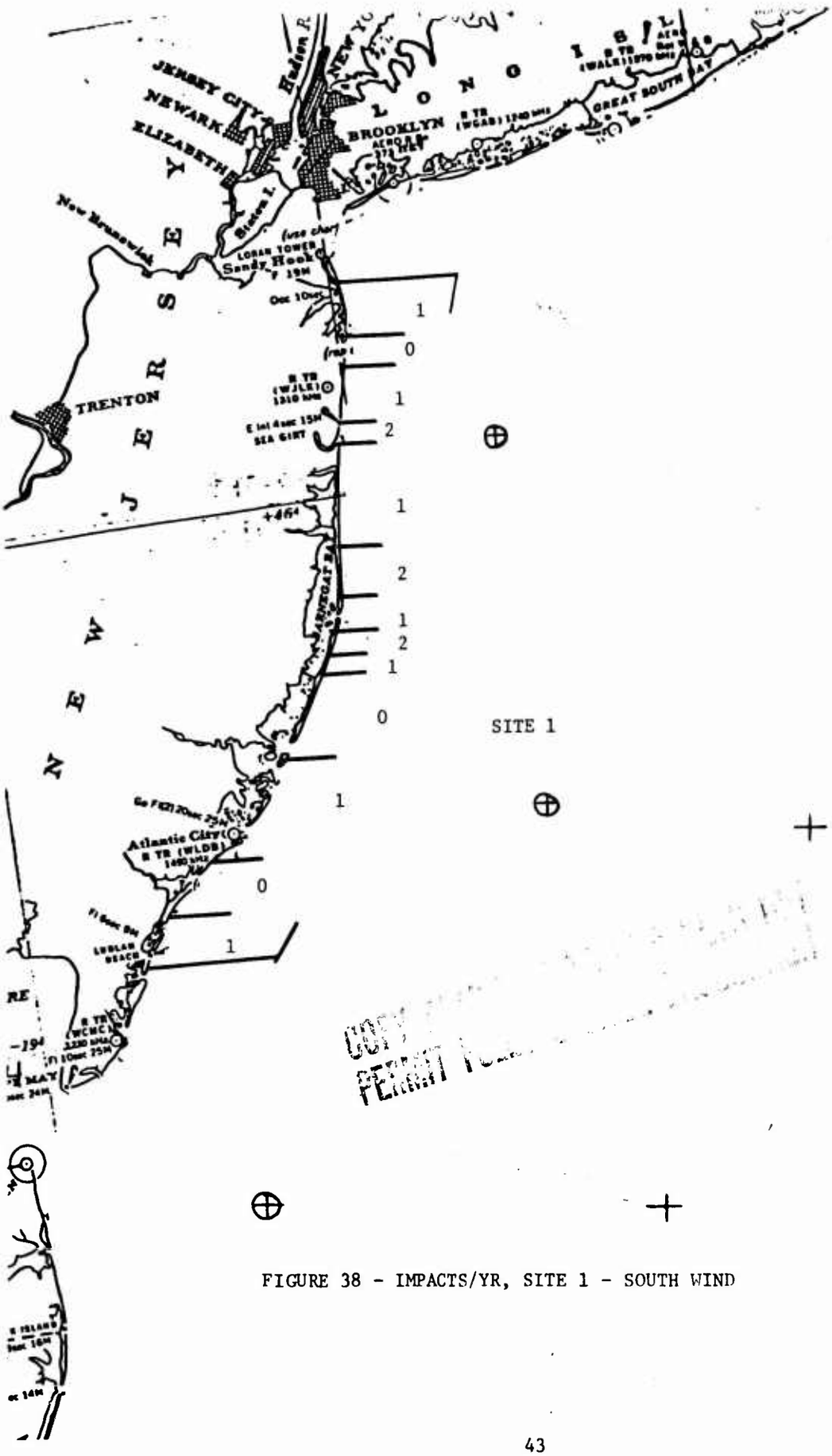
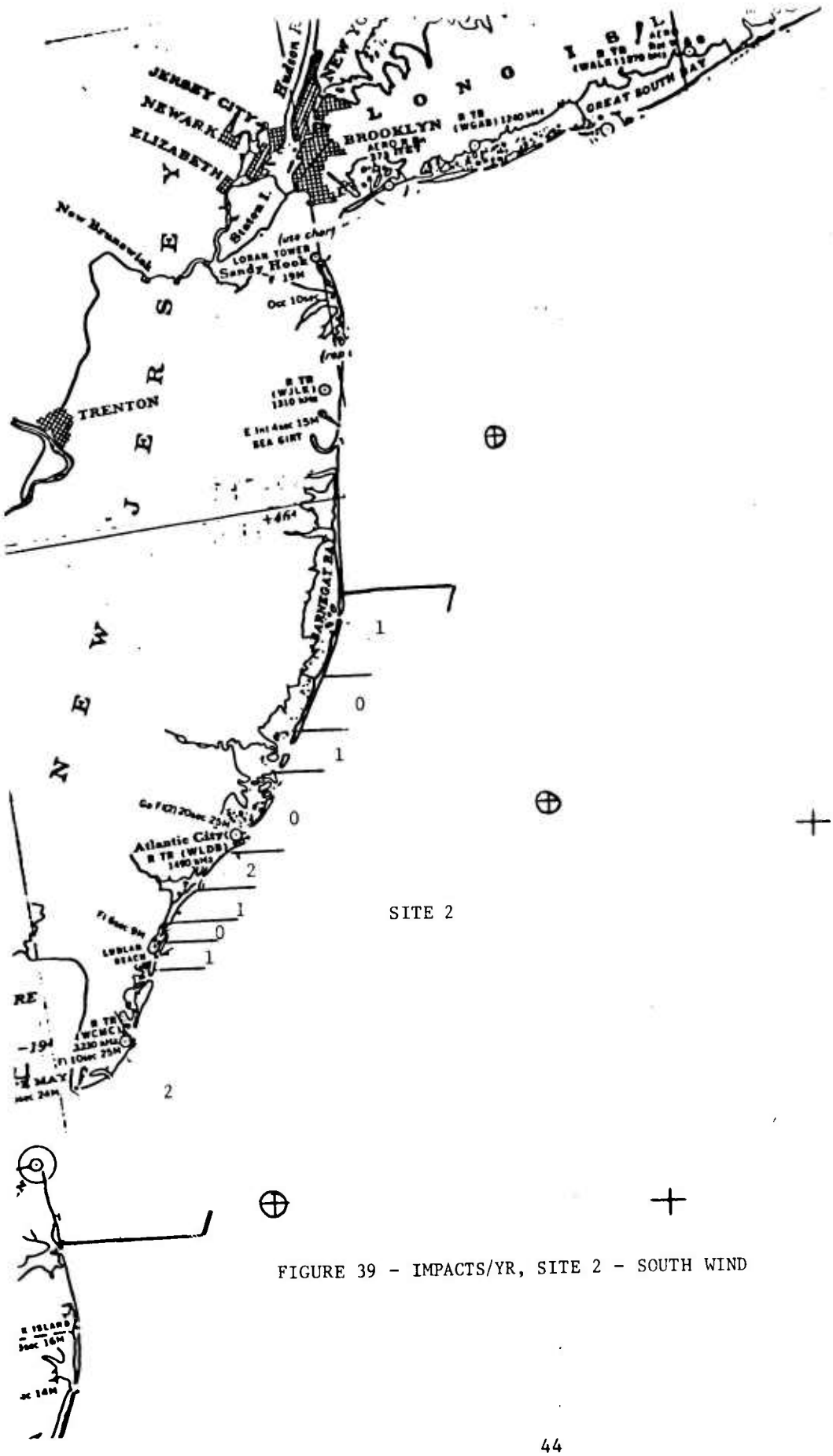


FIGURE 38 - IMPACTS/YR, SITE 1 - SOUTH WIND



SITE 2

FIGURE 39 - IMPACTS/YR, SITE 2 - SOUTH WIND

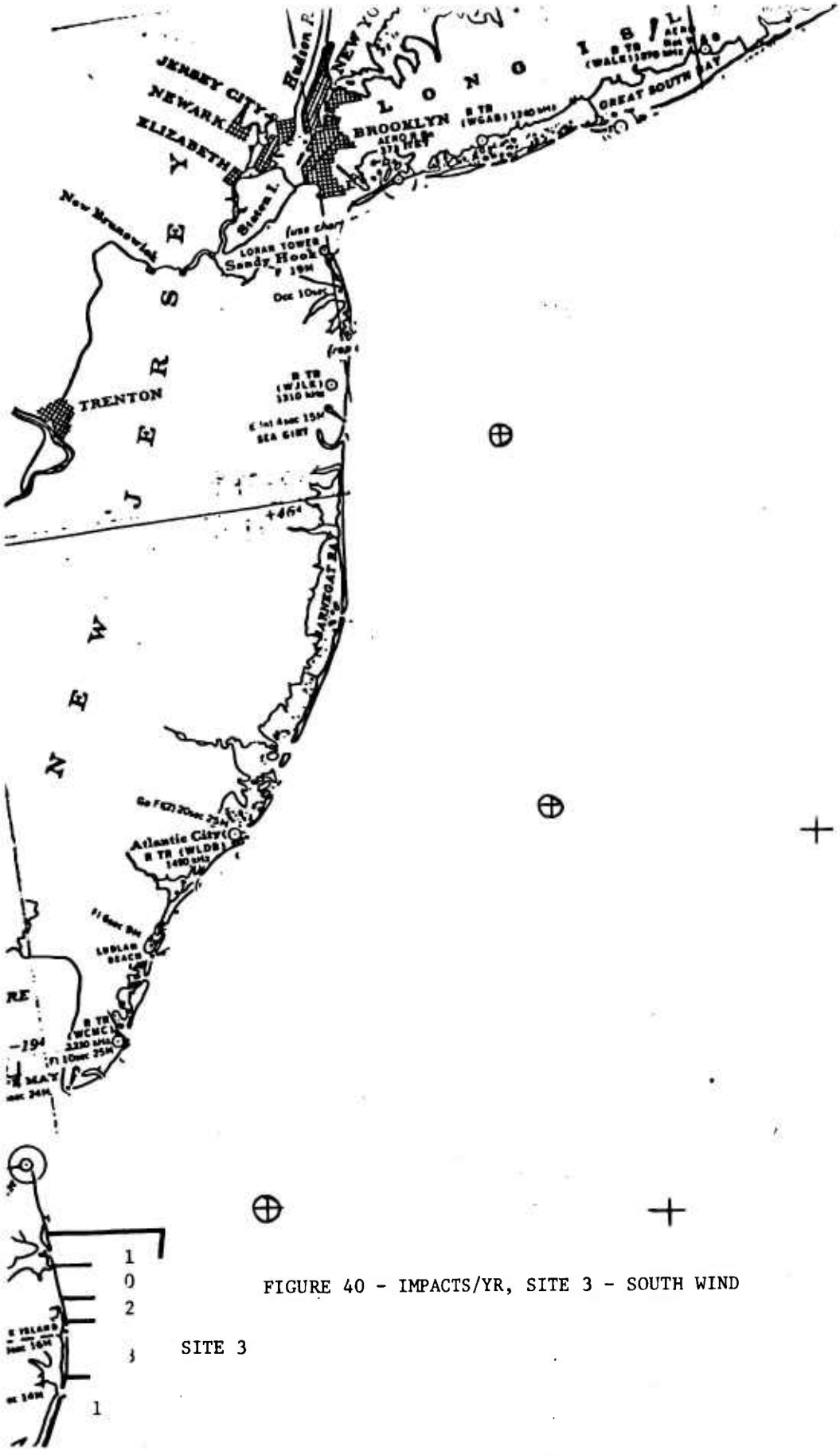


FIGURE 40 - IMPACTS/YR, SITE 3 - SOUTH WIND

SITE 3

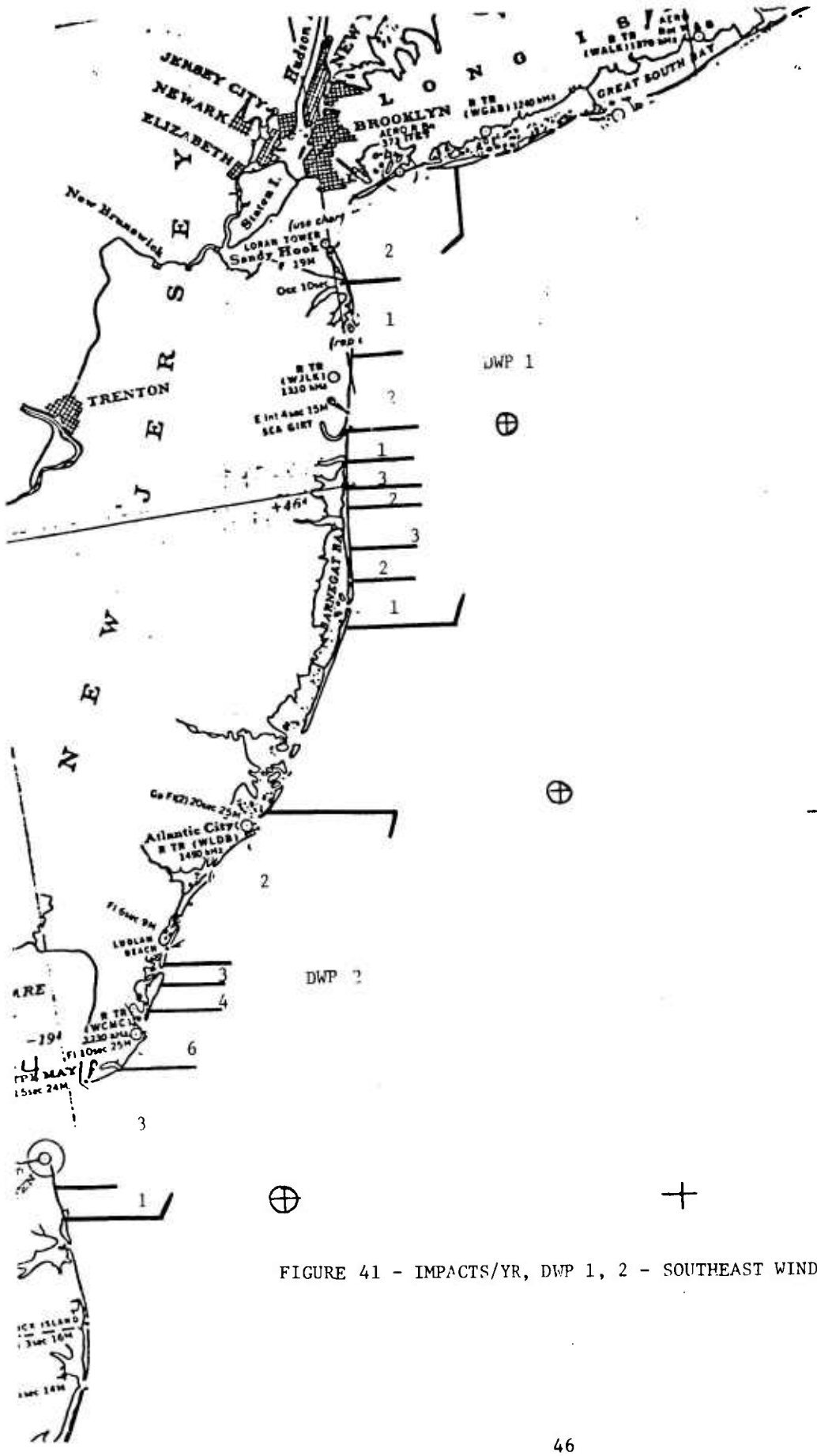


FIGURE 41 - IMPACTS/YR, DWP 1, 2 - SOUTHEAST WIND

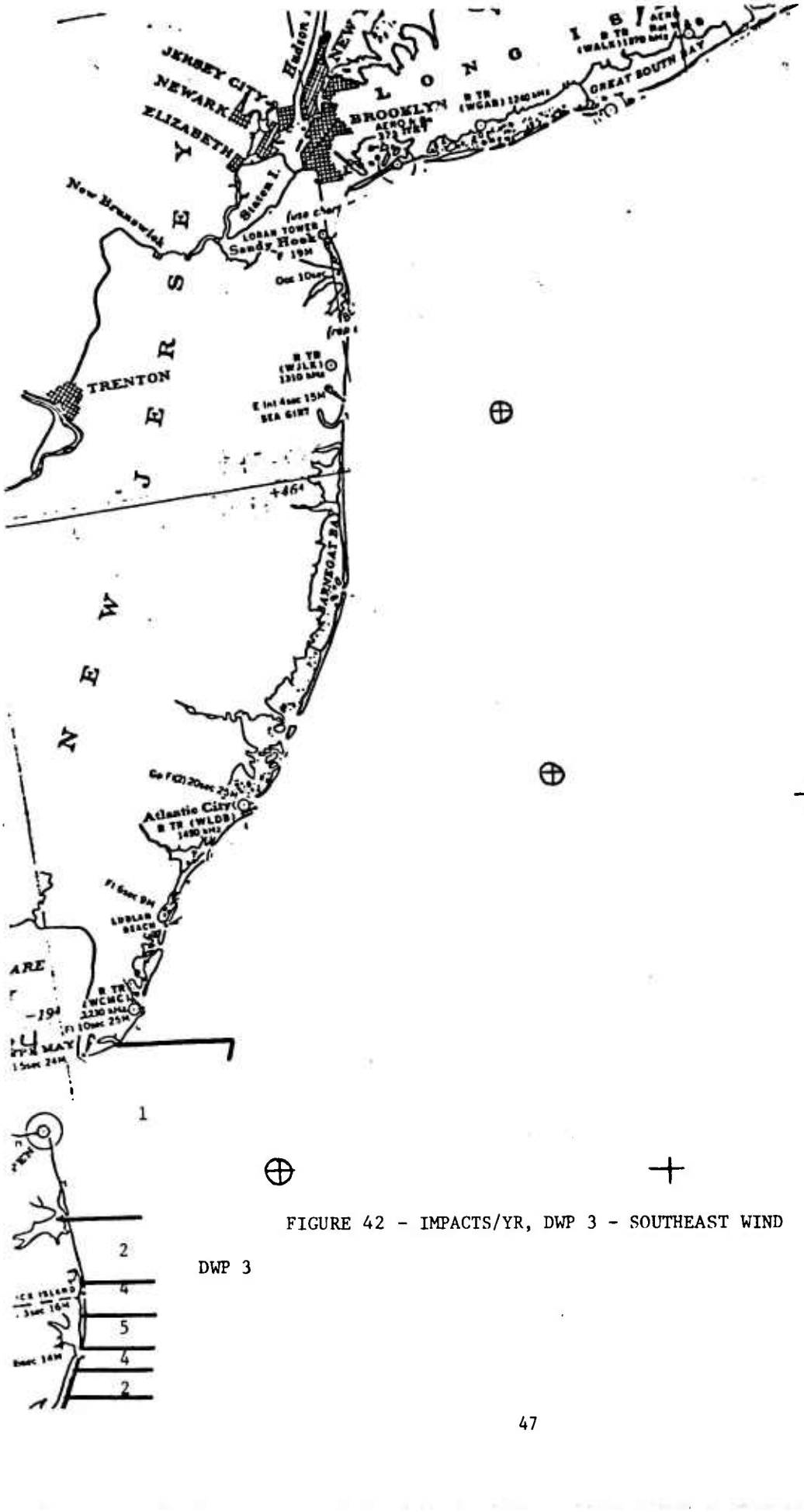
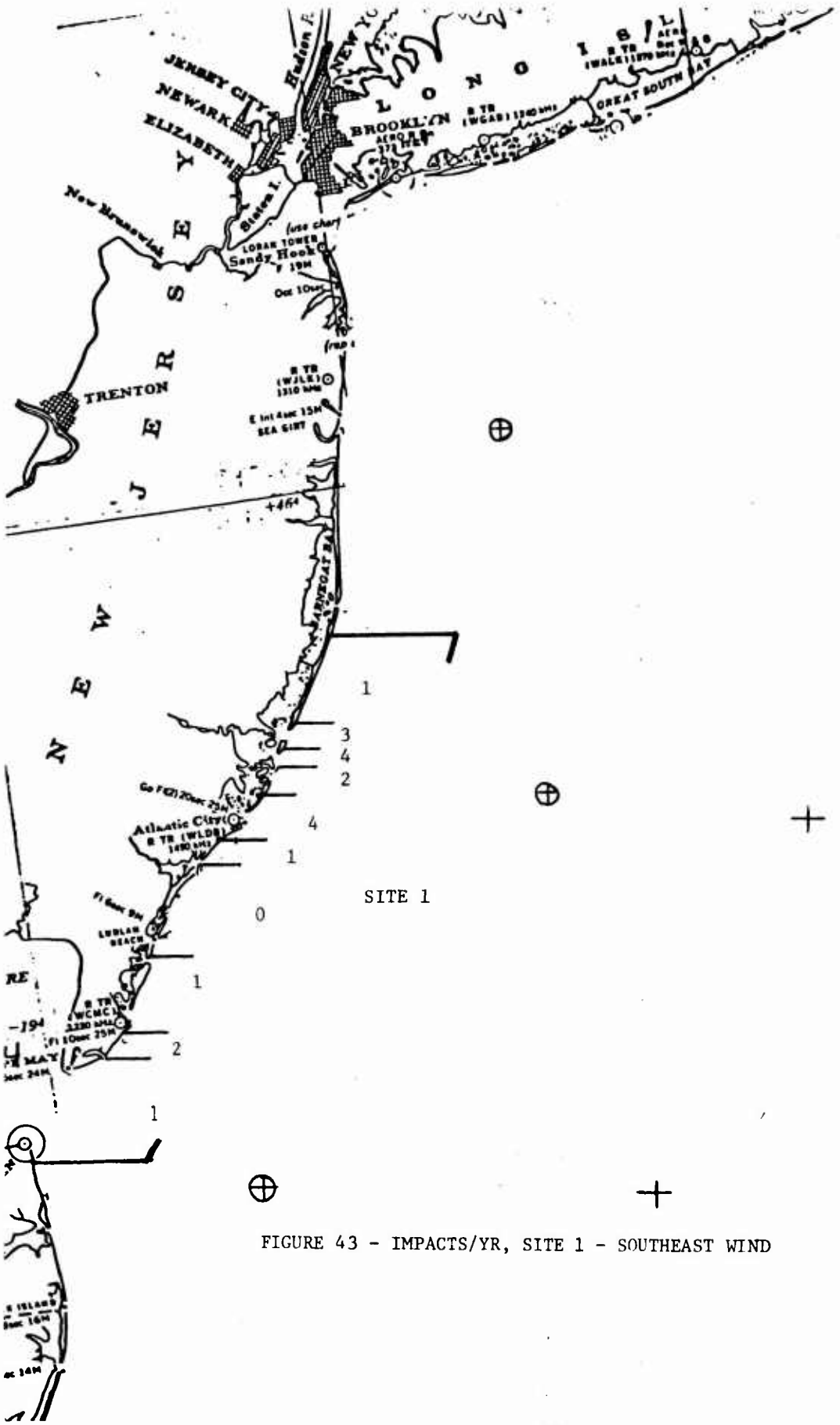


FIGURE 42 - IMPACTS/YR, DWP 3 - SOUTHEAST WIND

DWP 3



SITE 1

FIGURE 43 - IMPACTS/YR, SITE 1 - SOUTHEAST WIND

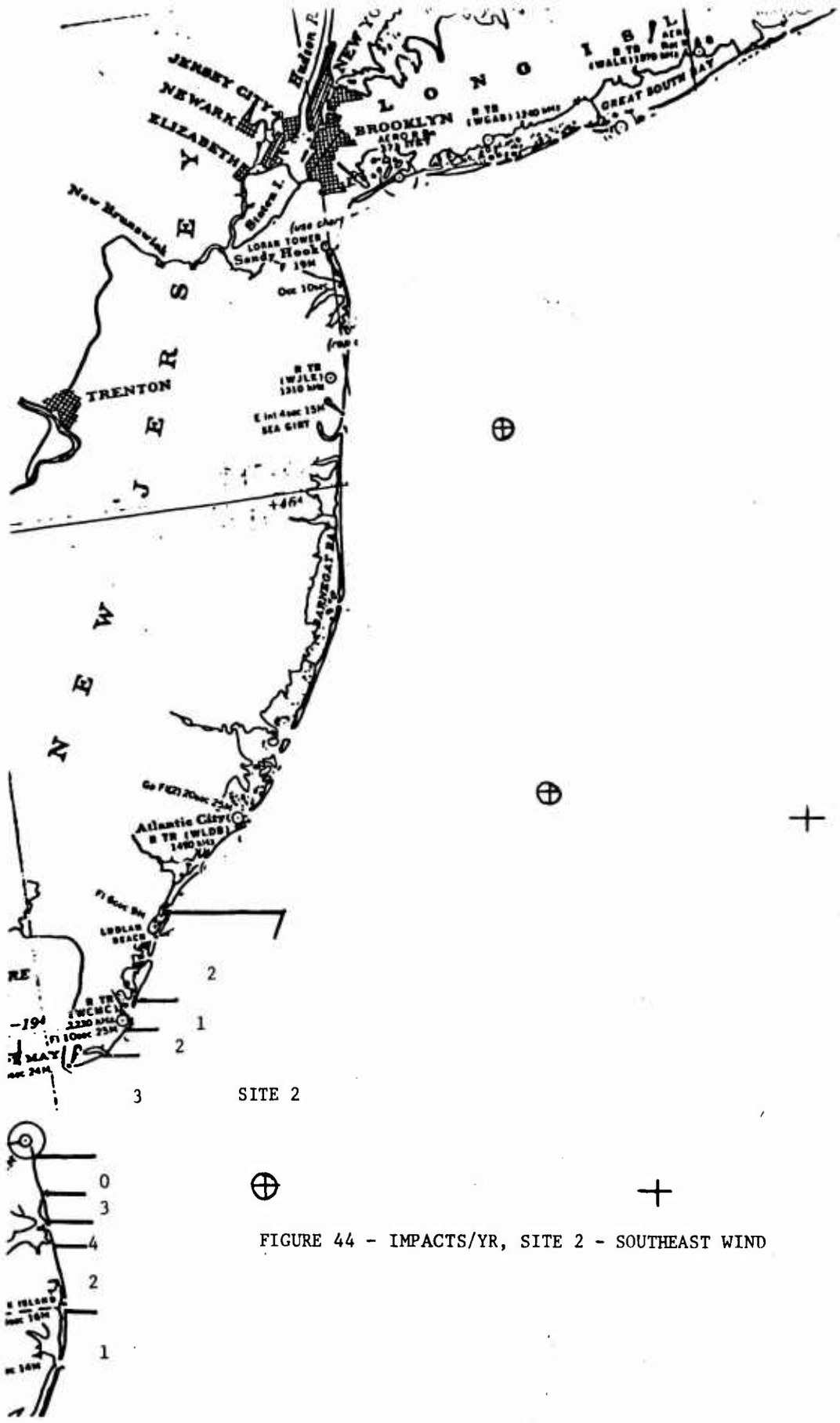


FIGURE 44 - IMPACTS/YR, SITE 2 - SOUTHEAST WIND

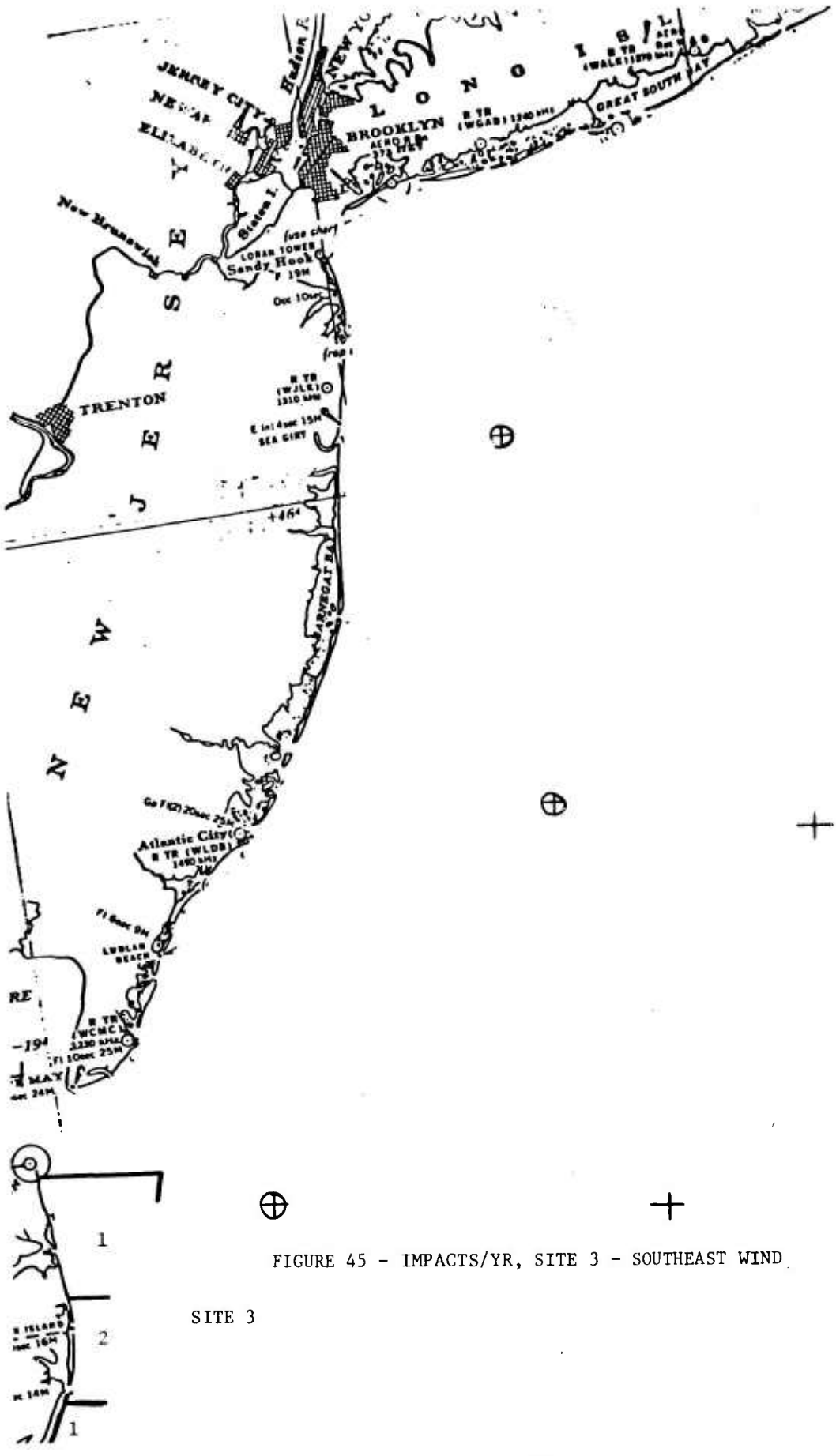


FIGURE 45 - IMPACTS/YR, SITE 3 - SOUTHEAST WIND

SITE 3

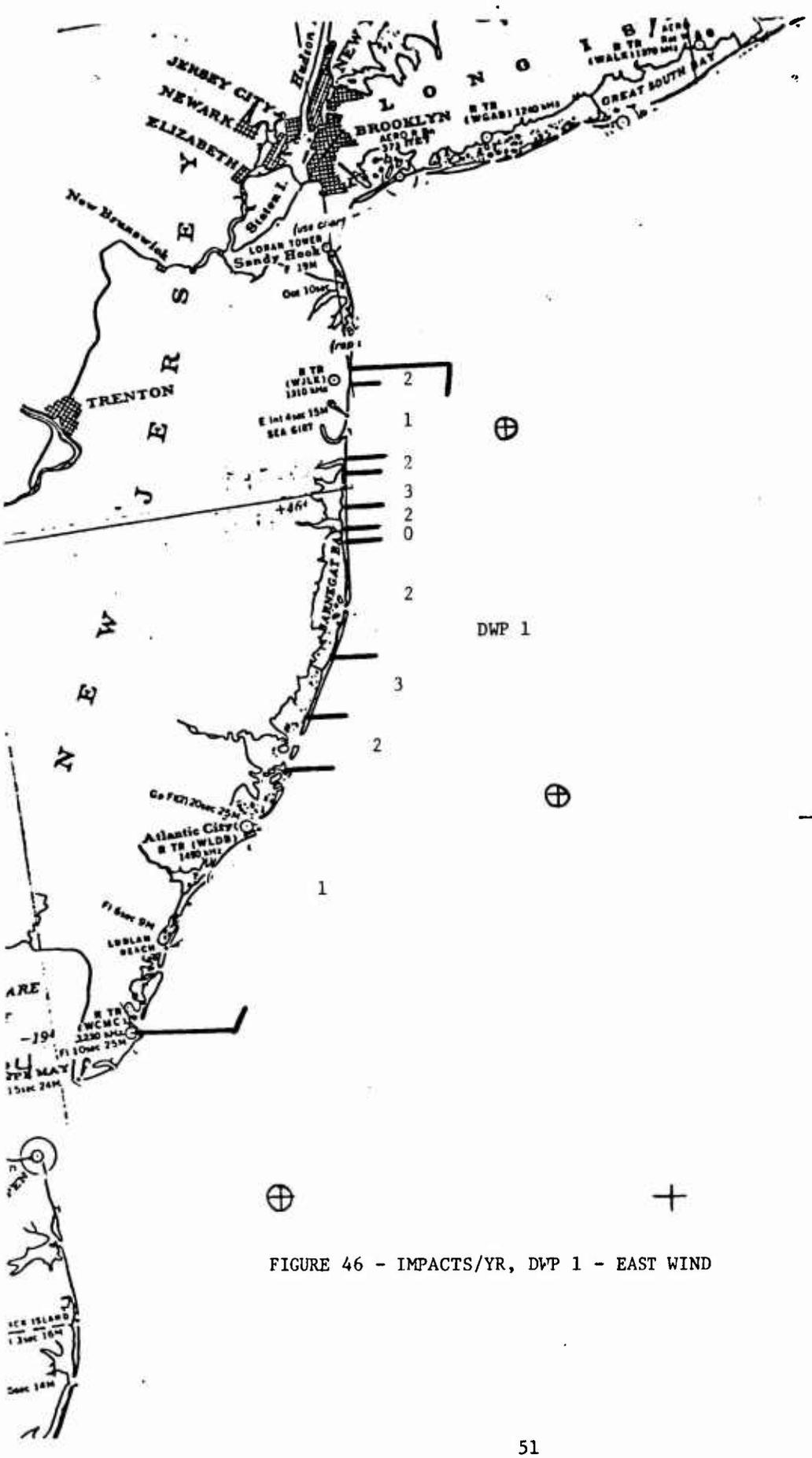


FIGURE 46 - IMPACTS/YR, DWP 1 - EAST WIND

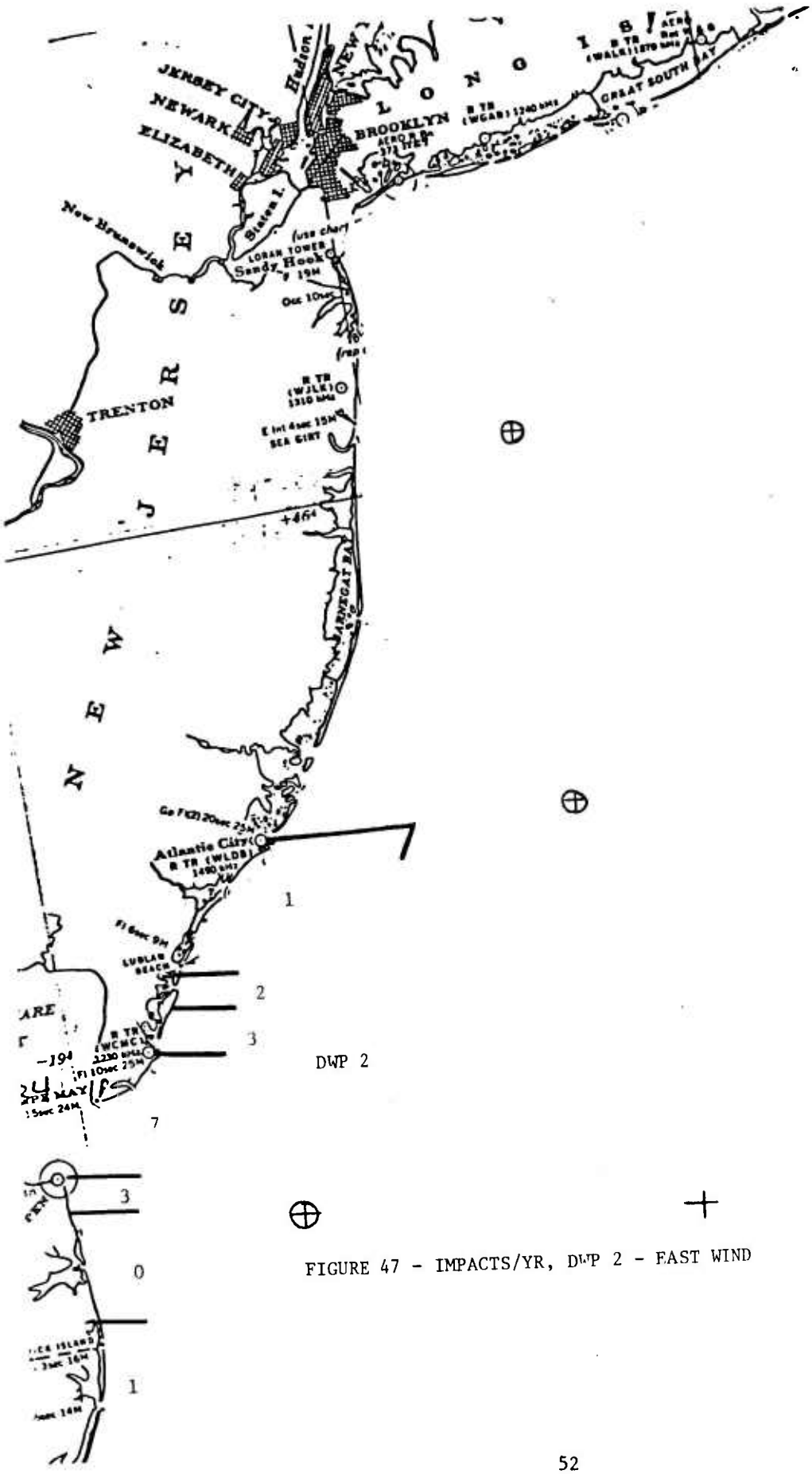


FIGURE 47 - IMPACTS/YR, DWP 2 - EAST WIND

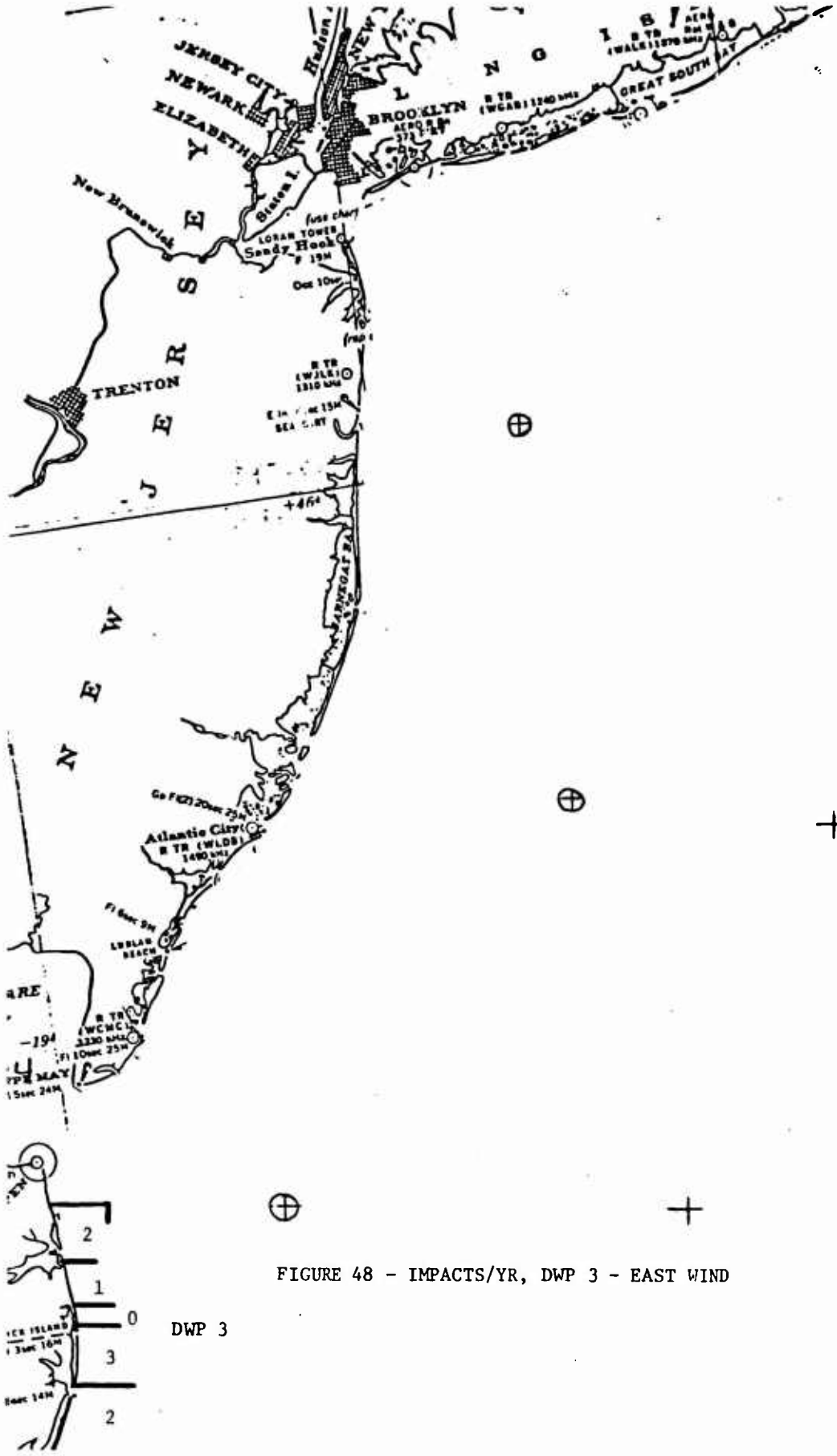


FIGURE 48 - IMPACTS/YR, DWP 3 - EAST WIND

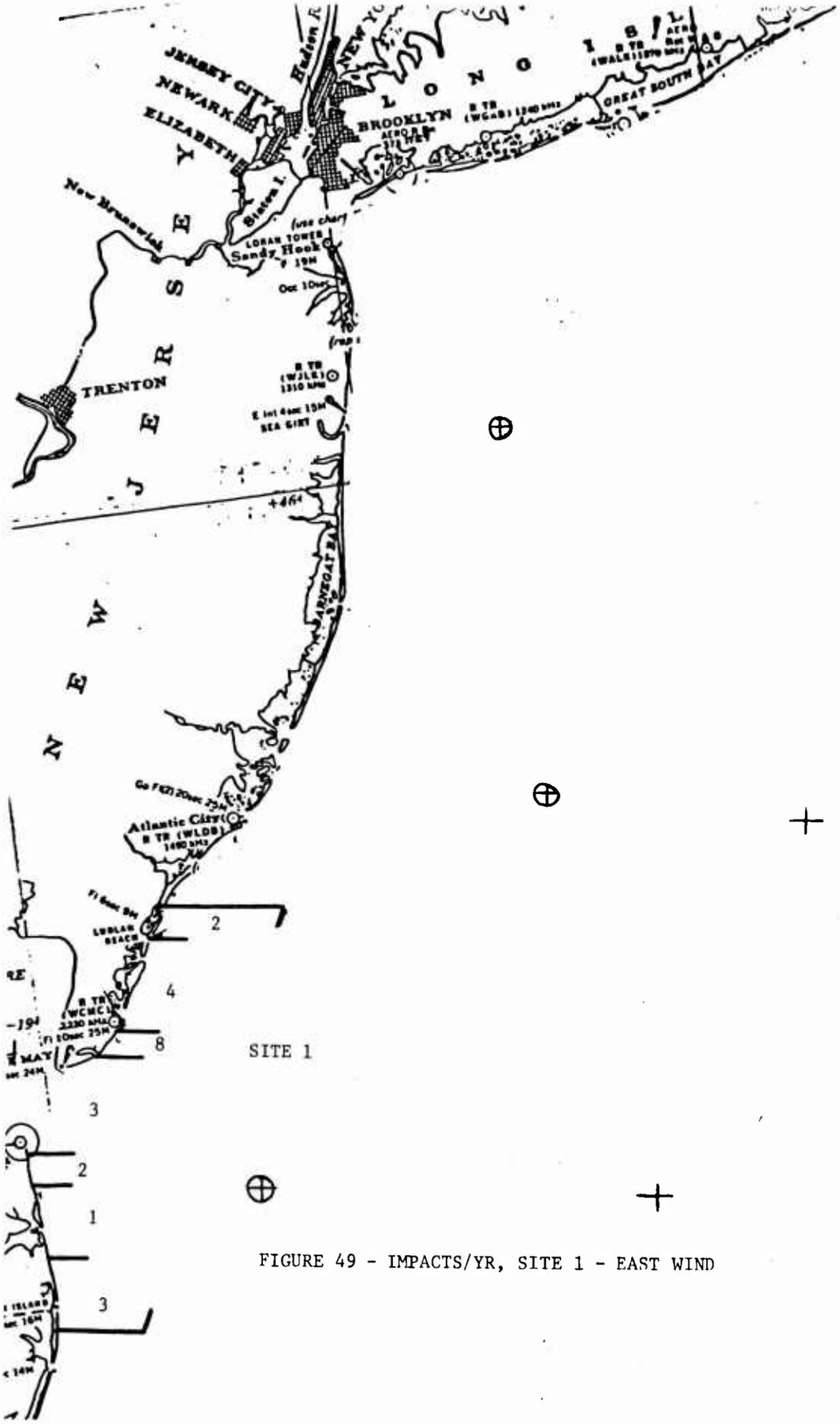


FIGURE 49 - IMPACTS/YR, SITE 1 - EAST WIND

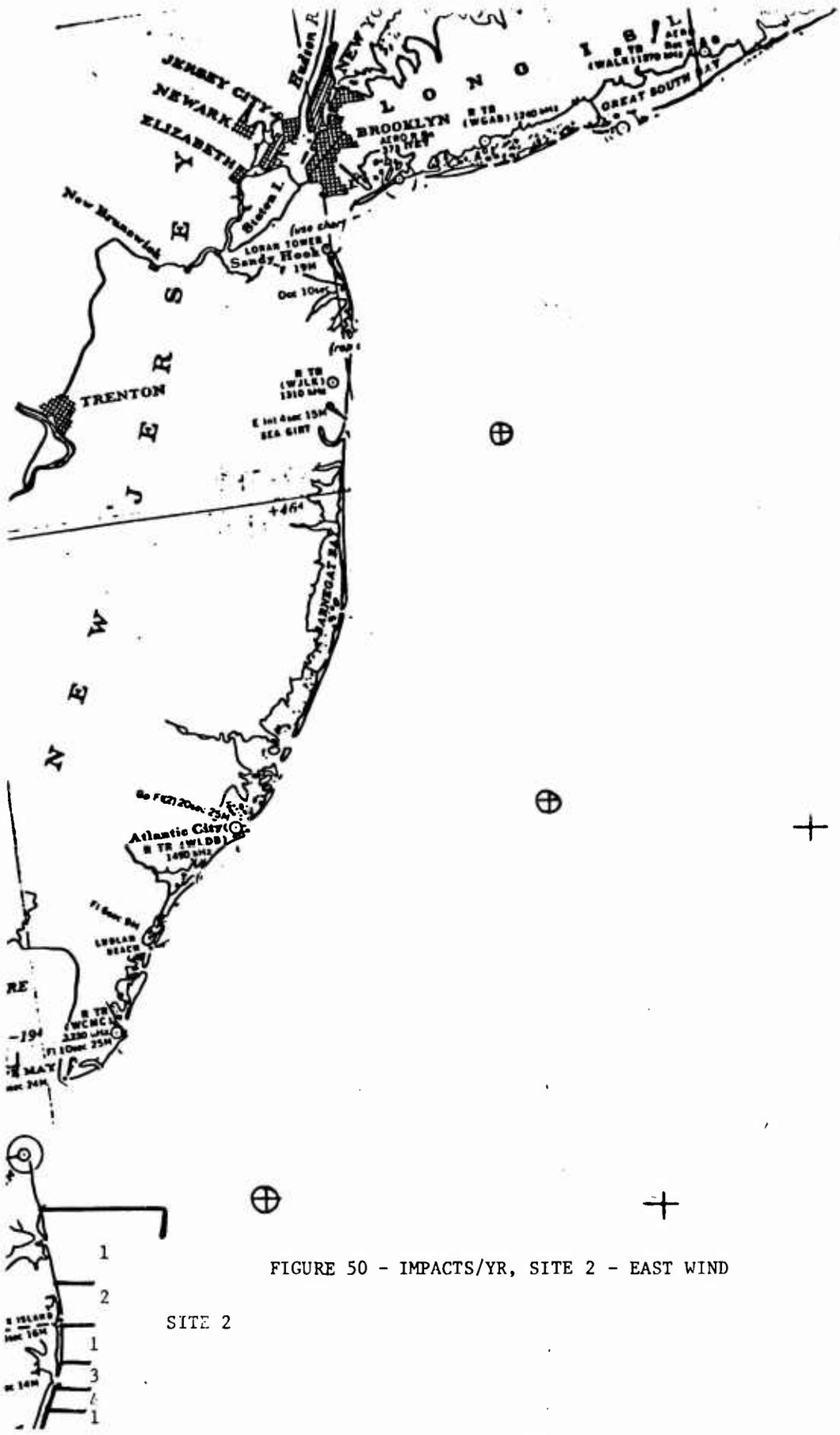


FIGURE 50 - IMPACTS/YR, SITE 2 - EAST WIND

SITE 2

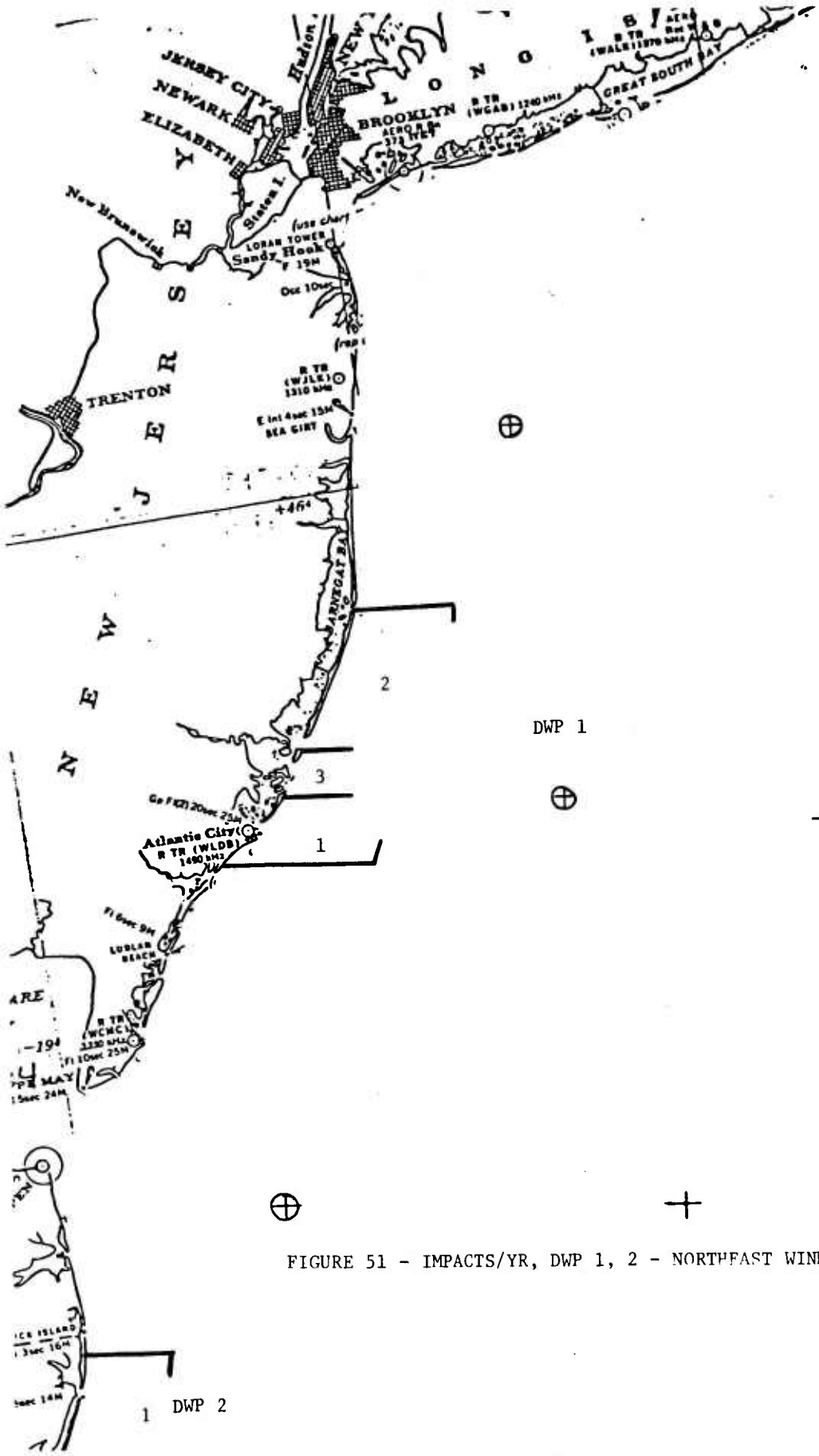


FIGURE 51 - IMPACTS/YR, DWP 1, 2 - NORTHEAST WIND

TABLE 1A

MONTH JANUARY LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
E	13.9	5.7	12	300	4	1 day to 8 miles north of Sea Girt (Figure 2)
S	13.3	10.2	12	340	7	1 day to reach beach, Jersey and Long Island coast (Figure 2)
SE	13.0	4.6	12	340	7	1 day to reach beach, Jersey Coast, Long Island. (Figure 2)
SW	14.0	13.9	12	340	7	1 day to reach beach, Jersey Coast, Long Island, and Raritan Beach. (Figure 2)
NE	16.6	7.3	12	260	4	1 day to beach between Sea Girt and Barnegat (Figure 2)

TABLE 2A

MONTH JANUARY LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
NE	16.4	8.6	14	235	3	2.5-3 days to Southern Delaware Coast (Figure 2)
E	15.1	4.8	14	250	3	3 days to hit North mouth of Delaware Bay/New Jersey Coast (Figure 2)
SE	12.7	3.9	14	260	5	3-4 days to hit beach between Atlantic City and Delaware Bay (Figure 2)

TABLE 3A

MONTH JANUARY LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.5	8.2	14.4	290	11	1 day to Delaware Bay (Figure 3)
SE	13.0	4.6	14.4	280	12	1 day to Delaware Bay (Figure 3)
E	13.9	5.7	14.4	260	12	1 day to Ocean City (Figure 3)
NE	16.6	7.3	14.4	220	28	5 days to entrance of Chesapeake Bay

TABLE 4A

MONTH JANUARY LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
NE	16.6	7.3	14.4	225	5	1 week to Virginia Capes.
E	13.9	5.7	14.4	245	5	5 days to reach lower New Jersey Coast (Figure 3)
SE	13.0	4.6	14.4	263	4	4 days to coast between Barnegat Bay and Atlantic City (Little Egg Inlet) (Figure 3)

TABLE 5A

MONTH JANUARY LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
SE	12.7	3.9	14.4	260	17	5 days to Delaware Bay (Figure 4)
E	15.1	4.8	14.4	240	27	4 days to Ocean City, Maryland (Figure 4)
NE	16.4	8.6	14.4	220	28	7 days to Chesapeake Bay.

TABLE 6A

MONTH JANUARY LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
SE	12.7	3.9	12.0	270	15.0	5 days to Cape Henlopen (Figure 4)
E	15.1	4.8	12.0	230	17.0	4 days to Virginia Beach.

TABLE 7 A

MONTH FEBRUARY LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
E	13.2	5.9	9.6	330	20	1 day to North of Barnegat Bay (Figure 5)
SE	12.5	5.3	9.6	275	20	1 day to Sea Girt (Figure 5)
S	11.8	10.0	9.6	275	5	3 days to North Jersey Coast (Figure 5)
NE	14.8	7.3	9.6	225	17	2 days to South Barnegat Bay (Figure 5)

TABLE 8A

MONTH FEBRUARY LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.4	8.2	12	270	9.5	3 1/2 days to Atlantic City (Figure 5)
SE	13.3	5.4	12	250	15	3 days to south of Ludlam Beach (Figure 5)
E	14.4	7.5	12	225	23	3-4 days to south of Cape Henlopen (Figure 5)
NE	16.5	9.2	12	215	28	3-4 days to Ocean City (Figure 5)

TABLE 9A

MONTH FEBRUARY LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.4	8.2	16.8	260	12	2-3 days to between Ocean City and Assateague.
SE	13.3	5.4	16.8	240	15	2-3 days to between Ocean City and Assateague.
E	14.4	7.5	16.8	240	15	2-3 days to between Ocean City and Assateague.
NE	16.5	9.2	16.8	230	17	2-3 days to between Ocean City and Assateague.

TABLE 10A

MONTH FEBRUARY LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.2	5.9	9.6	290	8.8	1 week to South of Sea Girt (Figure 6)
SE	12.5	5.3	9.6	270	14	5 days to Barnegat Bay (Figure 6)
E	11.8	10.0	9.6	250	19.5	5 days to Ludlam Beach (Figure 6)

TABLE 11A

MONTH FEBRUARY LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.4	8.2	14.4	260	7	12 days to Ludlam Beach (Figure 6)
SE	13.3	5.4	14.4	225	15	7 days to South of Cape Henlopen (Figure 6)
E	14.4	7.5	14.4	240	24	4-5 days to Cape Henlopen (Figure 6)

TABLE 12A

MONTH FEBRUARY LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.4	8.2	16.8	265	12	6 days to Ocean City (Figure 6)
SE	13.3	5.4	16.8	250	17.5	7 days to Virigina Beach.
E	14.4	7.5	16.8	230	19	6 days to Cape Henry.

TABLE 13A

MONTH MARCH LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
SW	12.2	11.6	12.0	290	7	Moving into North Jersey area (Figure 7)
S	12.2	12.1	12.0	N/NW	9	Caught in gyre at mouth of Hudson River (Figure 7)
SE	10.4	6.8	12.0	N/NW	9	Caught in gyre at mouth of Hudson River (Figure 7)
E	13.2	9.8	12.0	260	12	Due West on shoreline in 1 day (Figure 7)
NE	15.9	10.0	12.0	245	18	1 day to Barnegat (Figure 7)

TABLE 14A

MONTH MARCH LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.0	9.6	14.4	270	8	5 days West to Atlantic City (Figure 7)
SE	12.4	5.8	14.4	250	15	3 days to Ludlam Beach (Figure 7)
E	14.3	8.0	14.4	235	21	3 days to Delaware Bay (Figure 7)
NE	14.8	10.5	14.4	215	28	5 days to Assateague.

TABLE 15A

MONTH MARCH LOCATION DPW 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.0	9.6	14.4	250	11.0	2 days to Ocean City, Maryland (Figure 3)
SE	12.4	5.8	14.4	250	11.0	2 days to Ocean City, Maryland (Figure 8)
E	14.3	8.0	14.4	240	20.5	3 days to North of Assateague.
NE	14.8	10.5	14.4	220	24.0	5 days to V. Capes area.

TABLE 16A

MONTH MARCH LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	12.2	12.1	12	280	8.5	8 days to Barnegat Inlet (Figure 8)
SE	10.4	6.8	12	245	14	6 days to Atlantic City (Figure 8)
E	13.2	9.8	12	235	21.5	4 days to Ludlam Beach (Figure 8)
NE	15.9	10.0	12	225	25	In 5 days it will be 22 miles West of Ocean City, Maryland

TABLE 17A

MONTH MARCH LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.0	9.6	14.4	280	8	6 days to Little Egg Harbor (Figure 9)
SE	12.4	5.8	14.4	260	16.5	5 days to Ludlam Beach (Figure 9)
E	14.3	8.0	14.4	230	22	5 days to Ocean City (Figure 9)
NE	14.8	10.5	14.4	215	28	1 week to 10 miles off Chesapeake Bay.

TABLE 18A

MONTH MARCH LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.0	9.6	12.0	230	13	3 days to Ocean City (Figure 9)
SE	12.4	5.8	12.0	270	15.5	4+ days to reach Ocean City (Figure 9)
E	14.3	8.0	12.0	220	22	4 days to Chincoteague

TABLE 19A

MONTH APRIL LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
E	13.1	9.0	14.4	220	16	3-4 days to Atlantic City (Figure 10)
NE	13.5	7.9	14.4	SW	18	4 days south of Atlantic City (Figure 10)

TABLE 20A

MONTH APRIL LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.6	13.1	14.4	270	8.5	4 days to Atlantic City (Figure 10)
SE	12.0	7.5	14.4	240	20	3 days off Delaware Bay (Figure 10)
E	13.0	8.5	14.4	230	25	3 days to Fenwick Island (Delaware-Maryland border)(Figure 10)
NE	14.1	9.6	14.4	SW	22	5 days to Assateague.

TABLE 21A

MONTH APRIL LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.6	13.1	14.4	280	10	1-2 days into Delaware Bay on South Shore (Figure 11)
SE	12.0	7.5	14.4	250	14	2 days to Fenwick Island (Figure 11)
E	13.0	8.5	14.4	240	19	2 days south of Ocean City.
NE	14.1	9.6	14.4	220	22	2-3 days to Assateague.

TABLE 22A

MONTH APRIL LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.9	18.2	14.4	290	10	6 days to Sea Girt (Figure 11)
SE	11.1	9.6	14.4	240	16	6 days to Ludlam Beach (Figure 11)
E	13.1	9.0	14.4	230	20	6-7 days to Fenwick Island North of Ocean City (Figure 11)
NE	13.5	7.9	14.4	SW	20	8-9 days off Assateague and 10-11 days off Cape Charles.

TABLE 23A

MONTH APRIL LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.6	13.1	14.4	290	10.5	6-7 days to Atlantic City (Figure 12)
SE	11.0	7.5	14.4	250	15.5	7-8 days to Ocean City (Figure 12)
E	13.1	8.5	14.4	230	21	6 days to Assateague and be caught up in the Gulf Stream.

TABLE 24A

MONTH MAY LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.2	14.4	300	15	1-2 days to reach North[illegible]ey Coast (Figure 13)
SE	9.4	10.6	14.4	250	17	1 day to reach North of Barnegat Bay (Figure 13)
E	10.2	10.8	14.4	230	22	[illegible] day to reach Barnegat Bay (Figure 13)
NE	12.7	9.2	14.4	225	21	[illegible] days South of Barnegat Bay (Figure 13)

TABLE 25A

MONTH MAY LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.6	17.1	12	325	8.5	4-5 days to Barnegat Bay (Figure 13)
SE	10.2	7.1	12	250	14	4 days to Ludlam Beach (Figure 13)
E	11.0	9.0	12	240	16	3-4 days to Delaware Bay (Figure 13)
NE	13.0	12.1	12	220	22	6-7 days to North of Cape Charles.

TABLE 26A

MONTH MAY LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.6	17.1	13	335	9	2-3 days to Cape May and Delaware Bay (Figure 14)
SE	10.2	7.1	13	225	12	2-3 days to Ocean City (Figure 14)
E	11.0	9.0	13	220	18	2-3 days South of Ocean City
NE	13.0	12.1	13	200	21	5 days to Cape Charles

TABLE 27A

MONTH MAY LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.2	12.0	300	14	5 days to reach Northern Jersey Coast (Figure 14)
SE	9.4	10.6	12.0	260	14	5-6 days to Little Egg Harbor (Figure 14)
E	10.2	10.8	12.0	250	20	5-6 days to Delaware Bay (Figure 14)

TABLE 28A

MONTH MAY LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.6	17.1	12.0	310	8	8-9 days to Barnegat Bay (Figure 15)
SE	10.2	7.1	12.0	240	13	7-8 days to South of Cape Henlopen (Figure 15)

TABLE 29A

MONTH MAY LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
ALL DIRECTIONS						NO SPILLS WILL REACH SHORELINE

TABLE 30A

MONTH JUNE LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	26.6	16.8	260	12	1-2 days to Barnegat Inlet (Figure 16)
SE	9.6	11.2	16.8	240	15	1-2 days to Barnegat Inlet (Figure 16)
E	9.4	9.2	16.8	235	20	1 day to Barnegat Inlet (Figure 16)
NE	12.3	7.3	16.8	225	27	3+ days to Ludlam Beach (Figure 16)

TABLE 31A

MONTH JUNE LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.0	13	245	10	5 days to Ludlam Beach/Cape May (Figure 16)
SE	9.1	7.1	13	240	14	3-4 days to Ludlam Beach/Cape May (Figure 16)
E	10.8	8.6	13	225	19	3-4 days to Entrance to Delaware Bay (Figure 16)
NE	12.4	10.0	13	210	24	6-7 days to Cape Charles.

TABLE 32A

MONTH JUNE LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.0	14.4	230	8	3 days to Ocean City (Figure 17)
SE	9.1	7.1	14.4	230	14	2 days to Ocean City (Figure 17)
E	10.8	8.6	14.4	220	22	1+ days to South of Ocean City (Figure 17)
NE	12.4	10.0	14.4	210	24	4 days to Cape Charles.

TABLE 33A

MONTH JUNE LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	26.6	14.4	260	10	6 days South of Barnegat Bay (Figure 17)
SE	9.6	11.2	14.4	240	16	6-7 days to Ludlam Beach (Figure 17)
E	9.4	9.2	14.4	230	21	6-7 days to Cape May and Delaware Bay (Figure 17)

TABLE 34A

MONTH JUNE LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.0	12	250	7	10-14 days to Cape May (Figure 18)
SE	9.1	7.1	12	245	14	6 days to Delaware Bay (Figure 18)
E	10.8	8.6	12	235	20	6 days to Ocean City (Figure 18)

TABLE 35A

MONTH JUNE LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.0	14	240	14	8 days South of Assateague.
SE	9.1	7.1	14	250	16	6 days to Assateague.
E	10.8	8.6	14	230	23	5 days to North of Cape Charles.

TABLE 36A

MONTH JULY LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.2	31.8	10.0	260	4	5 days to South of Sea Girt (Figure 19)
SE	8.1	11.5	10.0	250	11	2 days to North of Barnaget (Figure 19)
E	8.9	8.4	10.0	245	14	2 days to Barnaget Bay (Figure 19)
NE	10.2	5.7	10.0	225	20	3-4 days to Absecon Inlet/Atlantic City (Figure 19)

TABLE 37A

MONTH JULY LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.5	9.6	240	4	13-14 days to reach shore at Cape May (Figure 19)
SE	9.2	7.3	9.6	240	10	5 days to Cape May (Figure 19)
E	9.8	7.8	9.6	225	15	6 days to Delaware/Maryland border (Figure 19)
NE	10.6	9.1	9.6	210	18.5	6 days to Ocean City (Figure 19)

TABLE 38A

MONTH JULY LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.5	13.0	245	7	4 days to Delaware/Maryland border (Figure 20)
SE	9.2	7.3	13.0	240	15	1-2 days to Delaware/Maryland border (Figure 20)
E	9.8	7.8	13.0	230	18	1-2 days to Ocean City (Figure 20)
NE	10.6	9.1	13.0	215	23	2 days to South of Ocean City (Figure 20)

TABLE 39A

MONTH JULY LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.2	31.8	10.0	240	3.5	Very slow movement shoreward.
SE	8.1	11.5	10.0	250	9	7 days to 35 miles due east of Ludlam Beach
E	8.9	8.4	10.0	245	16	6 days to 28 miles offshore of Ludlam Beach

TABLE 40A

MONTH JULY LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.5	12.0	275	4	Approximately 18 days to reach the shoreline.
SE	9.2	7.3	12.0	250	9	12-13 days to North of Ocean City (Figure 21)
E	9.8	7.8	12.0	225	15	9 days to 7 miles south of Ocean City.

TABLE 41A

MONTH JULY LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.4	20.5	12.0	275	10	7 days to Cape Henlopen (Figure 21)
SE	9.2	7.3	12.0	260	15	5 days to Ocean City (Figure 21)
E	9.8	7.8	12.0	240	19	5 days to North of Assateague.

TABLE 42A

MONTH AUGUST LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	9.4	24.2	14.4	240	10	2 days to 5 miles north of Barnaget Inlet (Figure 22)
SE	7.6	8.7	14.4	230	15	2 days to Barnaget Inlet (Figure 22)
E	8.8	9.3	14.4	220	18	2 days to 10 miles South of Barnaget Inlet (Figure 22)
NE	11.9	10.0	14.4	213	24	2 days to Little Egg Inlet (Figure 22)

TABLE 43A

MONTH AUGUST LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.0	16.4	12.0	270	7	5 days to Atlantic City, NJ (Figure 22)
SE	9.5	7.4	12.0	255	14	3 days to Great Egg Inlet (Figure 22)
E	10.3	9.1	12.0	240	18	3 days to mouth of Delaware Bay (Figure 22)
NE	12.2	11.8	12.0	215	22	5 days to 14 miles East of Assateague, moving parallel to the coast.

TABLE 44A

MONTH AUGUST LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.0	16.4	14.4	235	8	4 days to Ocean City Inlet (Figure 23)
SE	9.5	7.4	14.4	235	21	2 days to Ocean City Inlet (Figure 23)
E	10.3	9.1	14.4	235	16	2 days to Ocean City Inlet (Figure 23)
NE	12.2	11.8	14.4	205	23	4 days skirting the shoreline arriving at Cape Charles.

TABLE 45A

MONTH AUGUST LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	9.4	24.2	13.2	260	9	9 days to Little Egg Inlet/Atlantic City area (Figure 23)
SE	7.6	8.7	13.2	250	15	5-6 days to Atlantic City (Figure 23)
E	8.8	9.3	13.2	230	19	7 days to Delaware/Maryland Border (Figure 23)

TABLE 46A

MONTH AUGUST LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.0	16.4	13.0	255	7	13 days to mouth of Delaware Bay (Figure 24)
SE	9.5	7.4	13.0	250	15	6-7 days to mouth of Delaware Bay (Figure 24)
E	10.3	9.1	13.0	235	21	5 days to Ocean City Inlet (Figure 24)

TABLE 47A

MONTH AUGUST LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.0	16.4	12.0	270	6.0	12 days to Delaware/Maryland Border (Figure 24)
SE	9.5	7.4	12.0	240	13.0	8 days to 10 miles south of Assateague.
E	10.3	9.1	12.0	220	19.0	7 days to Cape Henry area.

TABLE 48A

MONTH SEPTEMBER LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.1	17.7	12.0	270	8	3 days to 5 miles South of Sea Girt (Figure 25)
SE	8.7	9.3	12.0	265	13	2 days to Sea Girt (Figure 25)
E	10.5	11.0	12.0	240	20	1 day to 5 miles North of Barnaget Inlet (Figure 25)
NE	14.2	12.8	12.0	215	25	2 days to Little Egg Inlet (Figure 25)

TABLE 49A

MONTH SEPTEMBER LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.9	12.6	12.0	260	8	6 days to Ludlam Beach (Figure 25)
SE	10.0	7.3	12.0	245	13	4 days to Cape May, NJ (Figure 25)
E	12.0	11.9	12.0	230	20	4 days to 5 miles North of Delaware/Maryland Border (Figure 25)
NE	14.4	16.5	12.0	200	25	6 days to 25 miles off of Cape Charles moving parallel to the coastline.

TABLE 50A

MONTH SEPTEMBER LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.9	12.6	14.4	245	8	3-4 days to Delaware/Maryland Border (Figure 26)
SE	10.0	7.3	14.4	240	15	2 days to Ocean City Inlet (Figure 26)
E	12.0	11.9	14.4	235	22	1-2 days to south of Ocean City Inlet (Figure 26)
NE	14.4	16.5	14.4	215	27	4 days to Cape Charles area.

TABLE 51A

MONTH SEPTEMBER LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.1	17.7	12.0	240	7	15 days to 10 miles South of Atlantic City (Figure 26)
SE	8.7	9.3	12.0	250	14	6 days to Atlantic City (Figure 26)
E	10.5	11.0	12.0	235	19	6 days to mouth of Delaware Bay (Figure 26)

TABLE 52A

MONTH SEPTEMBER LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.9	12.6	12.0	250	6.5	16 days to Cape Henlopen (Figure 27)
SE	10.0	7.3	12.0	245	13.5	7-8 days to mouth of Delaware Bay (Figure 27)
E	12.0	11.9	12.0	235	18	6 days to Ocean City Inlet (Figure 27)

TABLE 53A

MONTH SEPTEMBER LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	10.9	12.6	14.4	250	9.0	10 days to 5 miles North of Assateague.
SE	10.0	7.3	14.4	245	15.0	7 days to 15 miles South of Assateague.
E	12.0	11.9	14.4	240	22.0	6 days to Cape Charles.
NE	14.4	16.5	14.4	220	27.0	6-7 days to Currituck Beach.

TABLE 54A

MONTH OCTOBER LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.0	13.1	13.0	275	10.0	2 days to Sea Girt (Figure 28)
SE	10.6	8.8	13.0	240	11.5	2 days to 10 miles North of Barnaget Inlet (Figure 28)
E	10.2	8.5	13.0	225	18	2 days to 8 miles South of Barnaget Inlet (Figure 28)
NE	15.6	12.3	13.0	220	25	2 days to Little Egg Inlet (Figure 28)

TABLE 55A

MONTH OCTOBER LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.8	9.0	14.4	260	11	4 days to Great Egg Inlet (Figure 28)
SE	11.3	6.7	14.4	250	17	3 days to Ludlam Beach (Figure 28)
E	13.3	10.4	14.4	240	23	3 days to the mouth of Delaware Bay (Figure 28)
NE	15.8	16.4	14.4	220	26.7	4 days to 10 miles North of Assateague.

TABLE 56A

MONTH OCTOBER LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.8	9.0	15.6	235	9	3-4 days to Ocean City Inlet (Figure 29)
SE	11.3	6.7	15.6	230	15	2 days to Ocean City Inlet (Figure 29)
E	13.3	10.4	15.6	220	21	2 days to 15 miles South of Ocean City Inlet.
NE	15.8	16.4	15.6	210	28	4-5 days to mouth of Chesapeake Bay.

TABLE 57A

MONTH OCTOBER LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.0	13.1	12.5	270	10	6-7 days to 5 miles North of Barnaget Inlet (Figure 29)
SE	10.6	8.8	12.5	255	15	5 days to Little Egg Inlet (Figure 29)
E	10.2	8.5	12.5	245	19	6 days to Cape May, NJ (Figure 29)

TABLE 58A

MONTH OCTOBER LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	11.8	9.0	14.4	260	8	10-11 days to 5 miles South of Ludlam Beach (Figure 30)
SE	11.3	6.7	14.4	245	16	6 days to 10 miles north of Delaware/Maryland Border (Figure 30)
E	13.3	10.4	14.4	230	23.5	4-5 days to just South of Ocean City Inlet (Figure 30)

TABLE 59A

MONTH OCTOBER LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
SE	11.3	6.7	16.8	235	17	8 days to Cape Charles.
E	13.3	10.4	16.8	230	25	6 days to 5 miles off Chesapeake Bay.

TABLE 60A

MONTH NOVEMBER LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.6	14.1	12	270	5	3-4 days to Sea Girt (Figure 31)
SE	10.7	5.3	12	230	7	6 days to 5 miles north of Barnegat Inlet (Figure 31)
E	14.5	5.0	12	225	16	2 days to 5 miles South of Barnaget Inlet (Figure 31)
NE	17.0	8.7	12	210	24	4 days to 19 miles off the mouth of Delaware Bay.

TABLE 61A

MONTH NOVEMBER LOCATION DWP 2 .

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.4	10.3	12	285	6	5 days to Little Egg Inlet (Figure 31)
SE	12.6	6.0	12	245	15	4 days to Cape May, NJ (Figure 31)
E	13.6	6.5	12	235	20	3-4 days to 10 miles South of Cape Henlopen (Figure 31)
NE	14.9	10.9	12	220	23	7 days to Cape Charles.

TABLE 62A

MONTH NOVEMBER LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.4	10.3	14.4	245	5	5 days to Delaware/Maryland Border (Figure 32)
SE	12.6	6.0	14.4	235	15	2 days to 5 miles north of Ocean City Inlet (Figure 32)
E	13.6	6.5	14.4	230	21	2 days to 10 miles south of Ocean City Inlet

TABLE 63A

MONTH NOVEMBER LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.6	14.1	14.4	270	10	7 days to Barnaget Inlet (Figure 32)
SE	10.7	5.3	14.4	215	18	6 days to mouth of Delaware Bay (Figure 32)
E	14.5	5.0	14.4	210	23	6 days to Delaware/Maryland Border (Figure 32)

TABLE 64A

MONTH NOVEMBER LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	14.4	10.3	14.4	265	7	11 days to Ludlam Beach (Figure 33)
SE	12.6	6.0	14.4	240	14	7-8 days to Delaware/Maryland Border (Figure 33)
E	13.6	6.5	14.4	235	23	5 days to 10 miles south of Ocean City Inlet (Figure 33)

TABLE 65A

MONTH NOVEMBER LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
SE	12.6	10.3	14.4	245	17	6 days to Assateague.
E	13.6	6.5	14.4	230	21	7 days to the mouth of Chesapeake Bay.

TABLE 66A

MONTH DECEMBER LOCATION DWP 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	12.6	9.0	12	240	4	5 days to 12 miles north of Barnaget Inlet (Figure 34)
SE	12.9	4.9	12	235	10	2 days to 5 miles North of Barnaget Inlet (Figure 34)
E	13.3	4.6	12	225	18	1 1/2 days to Barnaget Inlet (Figure 34)
NE	14.5	10.2	12	210	24	4 days to 7 miles off mouth of Delaware Bay.

TABLE 67A

MONTH DECEMBER LOCATION DWP 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.8	7.1	12.0	285	7	5 days to Little Egg Inlet (Figure 34)
SE	13.5	3.8	12.0	260	16	3 days to 5 miles North of Ludlam Beach (Figure 34)
E	14.1	5.2	12.0	240	21	3 days to mouth of Delaware Bay (Figure 34)
NE	15	7.0	12.0	225	26	4 days to 5 miles South of Ocean City Inlet

TABLE 68A

MONTH DECEMBER LOCATION DWP 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.8	7.1	12.0	285	8	4 days to Cape Henlopen (Figure 35)
SE	13.5	3.8	12.0	260	14	2 days to 5 miles north of Delaware/ Maryland Border (Figure 35)
E	14.1	5.2	12.0	235	18	2 days to 4 miles South of Ocean City Inlet (Figure 35)
NE	15.0	7.0	12.0	215	24	5 days to mouth of Chesepeake Bay.

TABLE 69A

MONTH DECEMBER LOCATION SITE 1

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	12.6	9.0	12.0	290	8	8 days to Sea Girt (Figure 35)
SE	12.9	4.9	12.0	255	17	4-5 days to Little Egg Inlet (Figure 35)
E	13.3	4.6	12.0	240	22	5+ days to mouth of Delaware Bay (Figure 35)

TABLE 70A

MONTH DECEMBER LOCATION SITE 2

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.8	7.1	14.4	270	7	9 days to 5 miles South of Atlantic City (Figure 36)
SE	13.5	3.8	14.4	255	17	5-6 days to Cape May (Figure 36)
E	14.1	5.2	14.4	240	27	4-5 days to 10 miles South of Ocean City Inlet.

TABLE 71A

MONTH DECEMBER LOCATION SITE 3

WIND DIR.	AVG. SPEED (KTS)	% TIME WIND BLOWS FROM GIVEN DIRECTION	CURRENT SPEED (Mi/Day)	OIL SPILL MOVEMENT DIRECTION	OIL SPILL MOVEMENT SPEED (Mi/Day)	FATE OF SPILL
S	13.8	7.1	14.4	255	5	16.5 days to 10 miles South of Ocean City Inlet.

References

Boicurt, W. C., (1974): Recent Current Measurements in the Southern Middle Atlantic Bight: Proceedings of Estuarine Research Federation Outer Continental Shelf Conference and Workshop, 121-130.

Bumpus, D. F., (1973): A Description of the Circulation on the Continental Shelf of the East Coast of the United States, Progress in Oceanography, Vol. 6, 111-157.

Charnell, R. F., and D. V. Hansen (1974): Summary and Analysis of Physical Oceanography Data Collected in the New York Bight Apex During 1969-1970, MESA Report No. 74-3

EG&G Environmental Consultants, (1975): Summary of Oceanographic Observations in New Jersey Coastal Waters near 39°28'N Latitude and 74°15'W Longitude During the Period May 1973 through April 1974, A Report to Public Service Electric and Gas Company.

Fay, J. A., and D. P. Hoult (1971): Physical Processes in the Spread of Oil on a Water Surface, U. S. Coast Guard R&D Report No. 714107/A1001.

Klemas, V., G. Davis, H. Wang, and W. Whelan (1975): A Cost Effective Satellite - Aircraft-Drogue Approach for Studying Estuarine Circulation and Shelf Waste Dispersion, Proceedings of Ocean 75 Conference.

Lissauer, I. M. (1974): A Technique for Predicting the Movement of Oil Spills in New York Harbor, U. S. Coast Guard Research and Development Center Report No. CG-D-6-75, National Technical Information Service Report.

Schwartzberg, H. G., (1970): Spreading and Movements of Oil Spills, National Technical Information Service Report.

Smith, C. L., (1974): Determination of the Leeway of Oil Slicks, U. S. Coast Guard Research and Development Center Report No. CG-D-60-75, National Technical Information Service Report.

Tomczak, G., (1964): Ozeanographie 10, 129-130.

U. S. Naval Weather Command, (1970): Summary of Synoptic Meteorological Observations for North American Coastal Marine Areas, Volume II, National Technical Information Service Report.

U. S. Naval Weather Command, (1975): Summary of Synoptic Meteorological Observations for North American Coastal Marine Areas - Revised, Volume III, National Technical Information Service Report.

U. S. Naval Oceanographic Office, (1975): Summarized Surface Current Data, Monthly, Marsden Squares 116 and 152.

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